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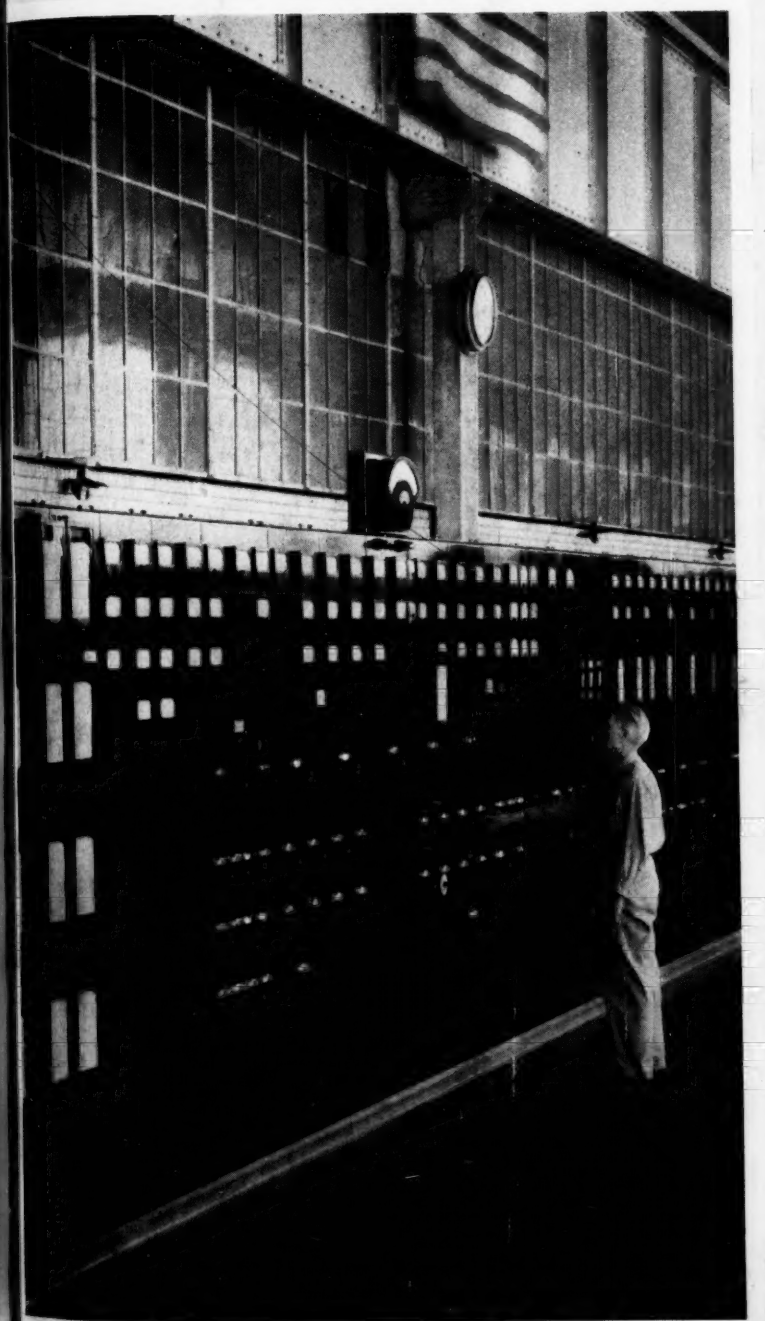
Power Plant ENGINEERING



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COVER: IN SUB-STATION OF FORD MOTOR CO.'s STEEL ROLLING MILL, THIS SWITCHBOARD HANDLES FIVE 13,800-V POWER LINES COMING FROM ROUGE POWER HOUSE, LARGEST HIGH-PRESSURE INDUSTRIAL POWER PLANT IN THE WORLD.

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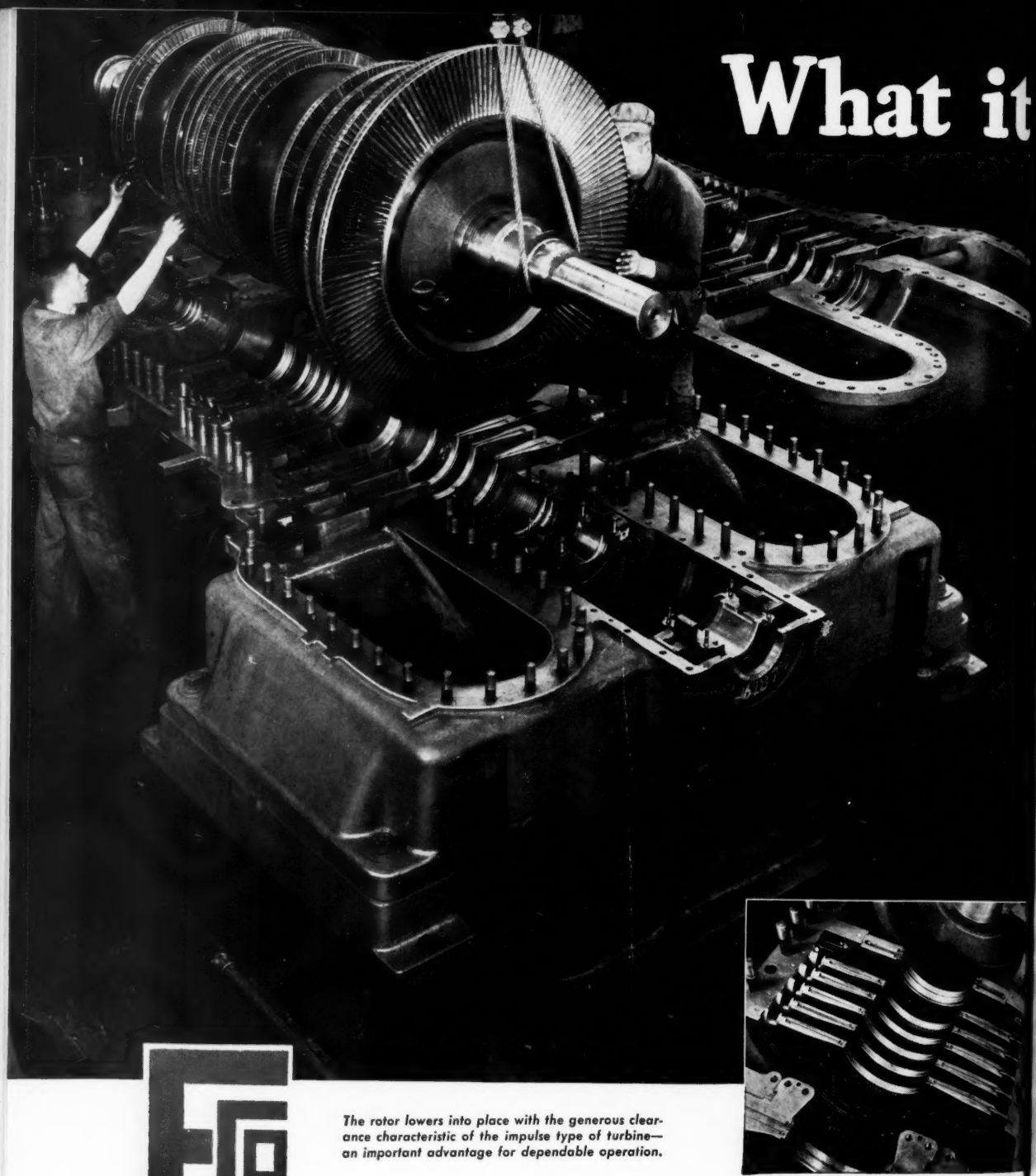
THE POWER ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY

MAY, 1947

What it



The rotor lowers into place with the generous clearance characteristic of the impulse type of turbine—an important advantage for dependable operation.

Diaphragms with milled nozzles, and interstage metallic packing, locked in casing grooves.

Elliott

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Editor

ANDREW W. KRAMER
Managing Editor

CHESTER R. EARLE
Associate Editor

THOMAS E. HANSON
News Editor

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EDWIN C. PROUTY, *Vice President*
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Power Plant ENGINEERING

May, 1947

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NOTICE

No illustrations nor written description could satisfactorily cover our new Automatic Hydrovac Dust Handling System. That's why we are using no more than the space necessary to announce it. . . . In justice to those interested, we feel the story must be obtained first-hand. . . . You just push a button —that's all. Immediately and at top speed dust is removed from one hopper after another, automatically and with no wasted time, regardless of the amount of dust in the various hoppers. It will skip over boilers off the line and stop and warn you of any extraordinary conditions. . . . It's fool-proof and after our explanation, you will agree that it is more than a sound investment. May our representative give you this first-hand account?... The Allen-Sherman-Hoff Co., 233 S. 15th St., Philadelphia 2, Pa. Representatives in most principal cities.

ENGINEERS' PREVIEW

DIABOLUS PENETRABILIS was a strange creature we discovered years ago running through a long pipe line that transmitted paper stock from one paper mill to another up in Wisconsin. His function was to keep the paper stock scraped off the sides of the pipe and he was propelled through the line by the velocity of the fluid. Translated, his name meant simply "Go-Devil." He has been known for years to operators of long pipe lines and among the most important of these are the oil pipe line companies. If you want to see a good picture of the modern Go-Devil and at the same time read many interesting details about the nation's widespread interstate oil pipe line network, with a map showing just where it runs, you will find it in the January 1947 issue of *The Lamp*.

★ ★ ★

A LIST of 864 standards approved for national use of industry by the American Standards Association is now available without charge, for general distribution. The revised list of standards includes many of those developed under war procedure and now approved for peacetime use. The standards listed include definitions of technical terms, specifications for metals and other materials, methods of work and methods of test for finished products. They reach into every important engineering field. They also include standards dealing with public and industrial safety, industrial medicine and a wide variety of consumer goods.

★ ★ ★

TECHNICAL DETAIL is now available to industry in general on the Transfax process, a new reproduction process for enabling prints to be made directly on the surfaces of various materials from working drawings, film negatives or film positives. It offers a quick and accurate means of reproducing templets, dials, nameplates, wiring diagrams and other types of images on such materials as metals, plastics, rubber and wood. It is done by the use of a Transfax spray, which is a light-sensitive preparation that can be applied to various types of surfaces without the use of a darkroom. It is claimed that it can render lines 0.003 in. apart. All you need to put Transfax to work is a space equipped with clean compressed air, a pair of spray guns, a printing frame, a strong light source, a bath of Transfax solution and a hose with spray nozzle supplied with warm water.

★ ★ ★

TUFFALT RB waterproof wall surfacing, by applying a second coat with texture and color over the first black coat, produces a finish resembling cement, plaster or stucco. Resists moisture, salt air and water, soil acids; neither flows nor runs from vertical surfaces at extremely high temperatures nor becomes brittle at low temperatures. Adheres to dry or damp surfaces, to moist mortar. Applied with broom, brush, trowel or spray, without heat or skill.

SIX SMALL hydraulic couplings for use with induction motors and small gasoline engines ranging from 1 to 25 hp at 1800 rpm, claim these advantages: Smooth acceleration, no stalling, engine or motor can be suited to actual running requirements, no need for shear pins, distribution of load on multiple drives, permit full-speed reversal of electric motor without high current surges, permit standard motors to start no load, thus produce high starting torque. All have two sets of blades on both driving and driven members; impellers and runners are lightweight aluminum castings.

★ ★ ★

NATURE has been somewhat inconsiderate in synthesizing the important organic compounds known as fatty acids. But today science is tailor-making them for many uses. During the war, United States industry used them to the extent of 500,000,000 lb a year and production has been steadily increasing. Yet the industry is still in its youth and faces a lifetime of growth. Fatty acids are considered essential to the processing and compounding of both natural and synthetic rubbers; are indispensable to the manufacture of the fastest air-drying types of protective coatings; serve as starting materials for most non-soap detergents, ore flotation and emulsifying agents. In addition, glycerine, a basic material of industry, is a by-product of fatty acid manufacture. What these acids are in nature, how they are synthesized and how used, is told in detail by Dr. Ralph H. Manley, in *Progress Through Research*, Vol. 1, No. 2. One of the most recent and important developments is that of Dr. Anderson W. Ralston of Armour Research Laboratories, who has developed uses for some of these substances in concentrating low grade iron ore. This development, by making it possible to use known deposits of low grade ore, has assured the United States of adequate supplies of high grade smelting ores for at least 150 years. Otherwise total exhaustion of the nation's high grade iron ore reserves would occur within a relatively few years. For this achievement, Dr. Ralston was awarded the 1947 Midwest Award of the St. Louis Section of the American Chemical Society.

★ ★ ★

CLAIMED TO BE very safe, Model CD-109-A Thermostat has no exposed electrical parts beneath the screen; has bakelite housing enclosed current-carrying parts, no larger than standard switches. It projects only 1 in. from the wall, is easy to install in a junction box. Current-carrying capacity 1500-volt-amps, ¼ hp and 125-volt-amps pilot duty at 125 v through 240-v a-c.

★ ★ ★

ALL-METAL Agitair FM Air Filter has layers of metal that induce turbulent action of the inside air, designed for efficient performance at 432 fpm approach velocity; handles 1200 cfm through a 20 by 20-in. filter panel, is easily removed for cleaning, servicing. Frame is welded cold rolled steel.

XUM

COHARDITE handles for wrenches, pliers, screwdrivers, other small tools, provide insulation, high impact strength, oils and grease resistance, a better grip, as well as superior appearance. Molded on a geon plastic combined with Hycar O R rubber.

★ ★ ★

KNOWN as L-CO, a new rubber-link skid-proof, shock absorbing industrial floor matting promotes safety, lessens fatigue; similar to household door mats. Sold by the square foot in any size, so that odd-shaped spaces can be fitted; special purpose mats for hard-work areas or wall-to-wall coverings.

★ ★ ★

MEN-E-USES variable-speed drive meets all fractional horsepower drive requirements from 20 to 750 rpm with 1,750 rpm motors; gets down to 4 rpm with additional auxiliary shaft. Aluminum housing and base, weight 12 lb, universal motor mount takes up to ½ hp. Power drive operates in either direction.

★ ★ ★

THE MO-4 MULTIBREAKER for protection of single-phase circuits has automatic over-current and short circuit protection for branch circuits, greater speed in tripping through thermal and magnetic characteristics. Made for circuits of 10 and 20 amp, plus 30 amp to conform to new ratings.

★ ★ ★

A LIGHT plastic safety cap for electric outlets fits any standard 110 or 220-v opening, is easily removed; being transparent fits home or plant color schemes, excludes lint, dust, grit, grease, moisture; can be wiped clean with a cloth; in home permits children to play near outlets since they can not insert pins nor wires; usable also for plants, mills, workshops, offices, etc.

★ ★ ★

REPAIR CLAMP to seal off pipe leaks quickly and permanently, in sizes from ½-in. to 30-in. diameters, is adaptable for all metal pipes, also asbestos-cement. Has a copper-band sleeves, which gives almost 100 per cent wrap-around without a tongue. Cast lugs, unique feature, can be reduced from 30-in. sleeves down to 3-in. in multiples of 3 in., without special tools, can be furnished in any sleeve length.

★ ★ ★

CEMEX, structural fireproof insulation, is made of long, tough, treated wood fibers coated with cement, compressed to desired thickness, 1- 2- and 3-in., air-dried and cured for maximum strength. In 4 by 4 ft slabs, with or without paper backing. When cutting and fitting is required it can be sawed like wood. Designed for sheathing, stucco bases, fireproof wall partitions, industrial roof decks, insulation for walls, floors, steel roof framing, etc.

★ ★ ★

LIGHTWEIGHT air and water gun, suitable for power plants, metal-finishing plants, motor-overhaul shops, all automotive and aircraft maintenance and repair, is controlled by finger-tip lever without valve adjustments. Designed for high-pressure rinsing, removal of grease and dirt from inaccessible places. Operates on regular air, water pressures; connects to standard fittings. Fits operator's hand, pressing one lever for high spray pressure.

NEW SMALL MOTOR designed to be explosion-proof because operated by air, centrifugal force of which against four sliding vanes, in shaft-mounted rotor, produces 0 to 6,000-rpm speeds. Will run continuously as slow as 100 rpm without stalling. Starts in any position, will not spark nor burn out due to overload or sudden braking. Model No. 0, 2½ in. in diameter weighs 2½ lbs; others to 1/6-hp, replace portable or stationary electric motors.

★ ★ ★

WAR-DEVELOPED hand tool, Tempotool, using explosive power, drives pins or studs into steel or concrete, is powered with cartridge enclosed in a breach similar to firearms, this forcing pin when exploded. Laboratory tests show a set-stud resists 20,000 lbs direct pull. Model 22 for attaching metal objects to ⅛-in concrete or steel; Model 38 on mild steel to ⅝-in; Model 45, mild steel to 1¼ in. This 6-lb tool packs a 20-ton punch, substitutes for drilling for supports, straps, angle iron, machine feet.

★ ★ ★

NEW FIRE-PROTECTION system for industrial plants, large offices, etc., controlled by a network of 15 thermostats spotted in as many strategic locations; warns at a central control and indicating unit of dangerous temperature changes. Each thermostat covers 4,800 cu ft. Any critical rise is indicated immediately on control unit while a bell rings, red light shows, the pointer showing location of trouble. No limit to system, 300 auxiliary thermostats can be wired into control device. Detecto-Master has safety features; if wire or thermostat is broken, displaced, disconnected, this records as for a fire, pointing to that numbered station. Available also with 'cold' thermostats to warn against temperature drops, as in cold storage warehouses.

★ ★ ★

COMMUNICATION system adaptable for installation on mine locomotives permits the operator to talk with a dispatcher or any other locomotive so equipped. The trolley wire is the power source as well as the carrier for the frequency-modulated wave. Each unit of equipment includes a small microphone and a loud-speaker. With the equipment installed, better haulage efficiency has been reported.

★ ★ ★

SOME WESTERN coals contain up to 5 per cent of fossil resins visible to the unaided eye. These are similar to those now imported in large quantities for use in varnish, lacquer, printing ink and linoleum manufacture. *Technical Paper 680* of the U. S. Bureau of Mines, entitled Resins in Coal, describes the occurrence, properties and purification of such material, and mentions proposed commercial uses.

★ ★ ★

SNOW-MELTING equipment has been successfully applied to driveways and sidewalks and is now to be used on a highway. The installation is being made on a 600-ft stretch of roadway from an American Cyanide Co. plant to a main thorofare over an uphill section that is virtually impassible in the snow and ice season. Eight wrought iron pipes, carrying 50 gallons of water per minute at 165 F, will provide a thawed area at each wheel track on the two-lane road. The system will melt 1-in. of snow or 0.1-in. of ice per hour, acording to *Science News Letter*.

★ ★ ★

HELPFUL BULLETINS

Answers to many operating and maintenance problems will be found in these new bulletins and catalogs. List paragraph numbers of those you want on coupon below, detach and mail.

BOILERS

1 **Modern Steam Generators**—This new bulletin on steam generators presents the reasons for the high efficiency, dependability and quality construction of the product and shows brief case histories of plants which have saved money by installing this company's equipment. The characteristics of design and construction of a typical unit are outlined through the medium of text and an excellently done sectional wash drawing of the unit. Features of construction of various parts of the boilers cover another two pages in the catalog. Results of tests by independent authorities and "Facts You Should Know About Steam Generating Units," are two other important sections. Ratings, dimensions, firing, measurements and other data are given on the last spread in the bulletin. Springfield Boiler Co.

2 **Steam Generator**—Fourteen pages are included in this collection of bulletins on steam generators, feed water pump sets. One of the bulletins on the steam generator shows the wide range of fuels, proved efficiency, quick steaming and safety of the unit. Burner controls are described and table of ratings and dimensions is published. The feed water pump sets are for use with the steam generator; tabular material, equipment and specifications are outlined, construction details are given, and operation is described. Cyclotherm Corp.

3 **Boilers, Auxiliaries**—This condensed catalog describes products, plants, facilities and services of this company. Facilities for casting and machine shop services are shown and many of the products produced are illustrated. Boilers, and the facilities for designing and producing them, are described on another page. Other products included in the catalog are condensers, evaporators, pumps, mixers, filters, etc. A cross-index of products and industries served is given on the back page and is arranged in such a manner that reference to any particular product is exceedingly easy. A description of the company's general maintenance service is completely described and a list of bulletins and catalogs available is given. Condenser Service & Engineering Co., Inc.

4 **Packaged Steam**—Described in this 8-page bulletin is a functionally-designed steam generating unit. The steam generator is reported to be fully automatic when burning all commercial standard grades of oil. Outstanding features of the boiler are listed and described in some detail. A double-page cutaway illustration of the unit printed in 4 colors shows path of gas travel and the interior construction of the unit. Specifications for the boiler equipment; for burner equipment when using No. 5 and No. 6 oil; burner equipment for light oil; extra equipment and gas-fired units is given on the inside back cover. Tabular material covers dimensions of all principal parts of the unit for the 17 different size generators in the line. Superior Combustion Industries, Inc.

AUXILIARIES

5 **Electrical Precipitation**—There are 28 pages in this booklet on the Cottrell Process of electrical precipitation. The booklet outlines the three gas cleaning problems which industry must face and from there goes on to show how the Cottrell electric precipitator works. Exceptionally fine drawings illustrate the process and detailed descriptions of construction of the unit are included. The larger part of the Bulletin consists of photographs of actual installations in power plants, smelters, acid plants, pulp and paper mills, etc. Research Corp.

6 **Oil, Gas Burners**—General Bulletin 745 is a recently-isued 12-page bulletin which tells about application of the company's line of oil and gas burners for industrial plants, public buildings, etc. The booklet starts off with photos of typical installations and then describes the details of the burners' construction. All parts of the burners are described and tables of sizes and rated capacities are included. Each part is illustrated. More complete details on the items, it is pointed out, are available in other bulletins. National Airoil Burner Co., Inc.

7 **Spreader Stoker Control**—Bulletin 1022, "Control for Spreader Stokers," gives data on approved automatic control layouts for spreader stokers. This 4-page bulletin illustrates and explains the operation of standardized component parts of the company's control system. Also shown are chart records illustrating the performance of a complete system. Several diagrammatic illustrations are presented as are pictures of separate parts of the controls. Bailey Meter Co.

BAFFLES, REFRACTORIES

8 **Handbook on Baffling**—This 18-page Bulletin BW 44 covers the story of the construction and application of these baffle walls to modern boilers and their use in modernizing existing units. Construction and erection of the baffling is described in detail in the front section of the booklet. This part is complete with line drawings, photographs, and wash drawings. Methods and desirability of streamlining boiler baffling is covered in a second section. Actual examples of changes which have been made in boiler baffles are shown and advantages which have been derived because of these changes are told. Drawings which illustrate the smoothness of gas flow produced by the baffling are shown. The Engineer Co.

9 **Refractories Handbook**—Heavy-duty refractories are covered in this 24-page engineering handbook and catalog. Among the types of engineering data presented are: temperature conversion chart, melting points of metallic elements, table of International Atomic Weights, tables of conversion factors, charts on expansion and conductivity of refractories, tables of standard brick dimensions, characteristics of refractories, two-page table of properties of refractories. Installation and application of heavy-duty refractories also are covered. The booklet is well illustrated. Norton Co.

10 **Refractory Cement Bulletin**—Physical properties of this air set cold setting refractory cement is described in this 4-page bulletin. "How-to-do-it" photographs show methods of mixing and methods of use. The advantages of the cement's high bonding strength, high refractoriness, low shrinkage and practical workability are described in detail. A table of characteristics of the various cements manufactured by the company is included. Armstrong Cork Co.

REGULATORS, METERS

11 **Propeloflo Meter**—Bulletin 350A describes this company's direct reading propeller type meter for main line metering. Ten outstanding features of construction are listed and applications, installation and the use in proportional feed control are described. A dimensioned line drawing and a chart of maximum flow are given. Specifications for other types of totalizing meters are given on the last page of the bulletin. Builders-Providence, Inc.

12 **Temperature Control Booklet**—Bulletin 5 "Automatic Temperature Control Systems" is a 20 page educational bulletin containing charts, tables and diagrams which explain measurement and automatic control and the selection of proper control systems for process applications. Two of the sections "Thermocouples, Their Placement and Hints Governing Their Use" and "Selection of Thermocouple Protecting Tubes" are covered in separate sections. Another section of great usefulness to the engineer is a listing of ASME terminology referring to processes and automatic control. The entire bulletin is presented in condensed form but contains excellent illustrative material such as sketches of end-results obtainable with automatic control, process reactions, effect of transfer lag, etc. Wheelco Instruments Co.

13 **Water Temperature Control**—This condensed Catalog 3035, contains a most complete line of regulators and thermostatic water mixing valves. These regulators and valves are designed for use on all types of hot water heaters and 3-way mixing valves for two temperature hot water systems. The units are described as applicable for shower baths, individual, gang and zone showers. Also for hospital hydrotherapy baths and other special applications. The Powers Regulator Co.

14 **Air Volume Controls**—A new air volume control for shallow well pumping systems is described in this recently-issued 4-page bulletin. Reasons for the design of the unit are outlined and line drawings and wash drawings illustrate the description. Three types of controls are included. United States Gauge Co.

15 **Flow Meters**—Bulletin T44 is a 12-page catalog which describes the company's "Ring Balance" flow meters. Principle of operation of the unit is described completely and a line drawing adds to the clarity of the description. Complete and detailed description of the ring balance integrator occupies one full page of the bulletin and is accompanied by two photographs. Catalog information on the various units in the line then follows and is accompanied by panel mounting drawings and principal dimensions. Ring Balance Instrument Co.

16 **Automatic Load Control**—This new bulletin tells about the company's engine-generator automatic load control which is said to provide fully automatic operation for any a-c engine generator set equipped with electrical starting system. Besides describing the control the bulletin shows, by means of wiring diagrams, how the five types of controls in the line may be used with 3 phase, 4-wire systems; single phase, 3-wire systems; 4-wire Delta system; single phase, 2-wire, a-c generator, etc. Prices for the equipment are given and prices and specifications of other types of controls are included. Engineering Controls, Inc.

DIESELS

17 **Diesel Engines, Generating Sets**—This bulletin describes power units of 3¼ to 56 hp, generating sets from 2000 to 36,000 watts and marine propulsion engines, 3¼ to 62 hp. Operating principle and a description of the simplicity and economy of operation of the units are covered in the first several pages of the bulletin. Typical installations of the units on river boats, in machine shops, fruit farms, foundries and hatcheries are presented. Detailed information on the simplified fuel injection system are given and multicolored illustrations describe the cooling and lubricating systems. Descriptions of various parts of the Diesel are accompanied by photographs and wash drawings. The booklet contains 16 pages. R. H. Sheppard Co.

ELECTRICAL

18 **Induction Motors Bulletin**—These two Bulletins C-118 and C-125, have just been issued. Both are 4-page catalogs and cover the company's "Series C" induction motors. Details of construction are emphasized and excellent wash drawings and line drawings are used for illustrative purposes. Protective insulation treatment is described in detail. A table of ratings is given. Reliance Electric & Engineering Co.

19 **1947 Reference Book, Buyers' Guide**—This 100-page reference book, buyers' guide and condensed catalog has just been issued; it covers the company's complete line of control devices, radio and electronic supplies. This exceedingly complete booklet includes everything from intercom systems to friction tape, from electronic tubes to electric drills. All items are priced and complete tables of specifications are included. Illustrations are included for nearly all items in the booklet. Walker-Jimieson, Inc.

20 **Voltage Regulators**—This new 16 page catalog describes the principle of operation and gives the technical specifications of

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POWER PLANT ENGINEERING

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MAY, 1947

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City ..... **State** .....

electronically controlled voltage regulators and Nobatrons. Many line drawings, consisting of circuit diagrams and graphs, show the inherent characteristics of these regulators. Applications to industrial work, laboratories, communications, sound and instruments are covered extensively. Technical specifications of the various models and lines are given in tabular form and the acompanying illustrations are printed with a brief physical description. Sorenson & Co., Inc.

21 **Motor Engineering Data**—Bulletin MU-185, is a 46-page engineering and price data bulletin on the company's line of motors; it is punched for loose-leaf filing. Included in the contents are engineering data for single-phase motors, consolidated price lists for fractional horsepower, integral horsepower, single-phase, polyphase and special motors. Engineering data for polyphase motors and catalogs for gear motors, multi-speed motors, elevator, crane and hoist motors. Descriptive material covers the product completely; it describes applications, ratings, mechanical variations, rotor construction and brush mechanism. Many parts of the motor, such as the switch-actuating mechanism and the rotor and quick-brake switch are described in detail. Many illustrations are included. Wagner Electric Corp.

22 **Electronic Servomechanism**—Illustrated and described in this catalog sheet is the company's new electronic servomechanism, Motron. The bulletin tells how the unit may be applied to the automatic control or regulation of a large variety of practical problems to eliminate the need of human supervision. Suggested uses such as air velocity control for sizing of coal and tracer controlled mechanisms such as oxy-acetylene cuttings are listed. W. C. Robinette Co.

PUMPS, COMPRESSORS

23 **Multi-Stage Pumps**—Catalog B-1146 deals with the company's vertically split-case multi-stage pumps which are built for capacities from 50 to 200 gpm. Six large performance curves for the 2½ by 1½ CS pumps are presented and complete details of construction, accompanied by line drawings, are given. A table of approximate weights and dimensions is printed. Economy Pumps, Inc.

24 **Spotting Air Where Needed**—Bulletin C-5 describes Fuller rotary air compressors; shows how these compressors, "spotted where you need air," eliminate the cost of long pipe lines, insure savings in power and maintenance. Fuller Co.

25 **Centrifugal Pumps**—Bulletin 246 contains specifications and construction details on this company's two stage centrifugal pumps. Capacity rating tables for various heads and speeds are given. A table of dimensions is accompanied by a dimensioned line drawing. The American Well Works.

26 **Rotary Pumps Catalog**—This company has followed up the recent introduction of a new rotary pump with this 2-color catalog. The bulletin describes the applications of the unit to power plants, oil refineries, breweries and many other installations. Detailed selection data, illustrations of both models and a close-up of the rotating element provide a clear picture of how to choose the right pump for a job. The bulletin also tells what you can expect from it in the way of performance. Illustrative material consists of cross-sections of the pumping elements of both models. Other information includes standard specifications with reference to body, head, rotors, etc. Sier-Bath Gear & Pump Co.

COUPLINGS, SPEED REDUCERS

27 **Engineering Manual**—This 92-page Engineering Manual and Catalog No. 114 covers the engineering, application, installation and use of the company's line of speed reducers. Inspection and Tests; Selection of Speed Reducers, Design and Construction, Lubrication and Oil Retention are some of the sections in the booklet. Many full page tables of horsepower and torque output ratings and overhung load capacities are included. The book is well illustrated with photos, sketches and blueprint-type drawings. The booklet is plastic-bound in a heavy cover. Winfield H. Smith, Inc.

28 **"Story of an Industry"**—The story of over half a century of progress by this company is told in this excellently done 46-page bulletin. The story starts in 1892 and describes the background of the country's economic situation. The products which were then manufactured are shown in thumbnail illustrations and as the story progresses the evolution of the company itself is portrayed by the changing character of the products illustrated. Starting into the Thirties the slow pace of industrial progress gave the company an opportunity to develop diversified production and methods of manufacture. In the Forties the country was plunged into another war and consequently the preparation for the greatest naval program in history had its effect upon the company's fortunes. War production achievement is described briefly and the booklet then shows the company's production front at the present time. Products they manufacture and industries they serve are briefly listed and the workmanship and quality of the products turned out are described. The reason behind this product—the employees, research and product development—conclude the booklet. The Falk Corp.

WATERPROOFING, CONSTRUCTION

29 **Construction Booklet**—This company states that if you are now planning or are engaged in, new building construction that the illustrated booklet will prove of definite interest. It is described as being valuable at any stage of building work from blueprint to finished job. It contains useful information on constructing foundations and basements, the laying of various types of floors, surfacing of interior and exterior wall surfaces, etc. It also points out many of the unusual conditions effecting the durability of finished construction which may be anticipated. Stonhard Co.

30 **Concrete Masonry Waterproofing**—A major problem in industry is the waterproofing of concrete masonry, especially where the masonry is under hydrostatic pressure as it so often is in power plants. This 16-page bulletin tells what this company's product is, how it works, and shows methods of applying. Photostatic evidence shows how the product enables concrete masonry to withstand hydrostatic pressure tests of 500 psi. Object of the tests is described and procedure, observations and conclusions are given. Some examples of the use of the product, Aquella, in concrete masonry construction are shown in photographs. Prima Products, Inc.

31 **Waterproofing Service**—Three products are described in this 16-page bulletin—one product stop leaks in walls and masonry, the second fills and seals the surface of the masonry and the third applies a finish coat. The bulletin presents an excellent series of photographs showing each of the products being applied to a concrete block wall. Make-up of the various compounds is described in the bulletin and examples of its use are quoted in case histories. Detailed descriptions of methods of applying the products to walls and even to deepening and widening cracks, crevices and holes is explained. Standard Dry Wall Products, Inc.

HEATING

32 **Unit Heaters Bulletin**—Bulletin 401 contains 16 pages and describes this company's blower fan type unit heaters. The bulletin is exceptionally well arranged and presents practically every bit of information which is necessary for specifying, ordering and installing the units. Typical of the features of the bulletin are chapters on capacities, conversion factors, dimensions of floor type, wall type, horizontal type and inverted type heaters. Transmission coefficients are presented in tabular form on two pages and piping diagrams are presented on another page. Airtherm Mfg. Co.

33 **Radiant Heating Control Handbook**—The 40 pages in this excellent book cover the theory and application of automatic control of radiant panel heating. The subject matter includes such material as Comparison of Panel and Convection Heating, The Function of a Heating System, Control Requirements of the Two Systems, Rational Solution of the Control Point Problem, etc. Charts, and piping and control diagrams are used to illustrate the booklet. Minneapolis-Honeywell Regulator Co.

VALVES, PIPING

34 **Tube Compensators Data Book**—Specifications and data for installation of compensators for flexible tubing are contained in this recently-issued data book. The booklet first tells what the compensators are and what they are designed to do. Line drawings are used extensively in the booklet to illustrate the points brought out. Two pages of typical installations are presented in which one column of line drawings shows the installed position, a second column the deflected position and a third column an explanation of the purpose for the compensator in this particular place and its resulting action. A compensating data chart for calculating required tube lengths is presented as are tables of thermal expansion of pipe and standard end fittings. Chicago Metal Hose Corp.

35 **Valve Data Book**—A 248-page catalog has just been issued; it is expected that this book will become one of the outstanding reference publications of the power field. According to the company this catalog sets a new high in the valve industry. It is profusely illustrated with outside and cross-sectional wash drawings of the line and is designed to assist engineers, production men, purchasing agents and management in selecting the right valve for the right job. Ohio Injector Company.

36 **Safety, Relief Valves**—Twenty basic designs of improved safety and relief valves are described and illustrated in a new condensed Bulletin 40. The valves described have been custom-built to users' specifications—users in the chemical, petroleum, marine and equipment manufacturing fields assisted in their design. The bulletin gives the essential construction and operation specifications briefly. Valve designs described include high pressure types, liquid relief, diaphragm relief, full venturi and semi venturi types of safety, relief, safety-relief and pop valves. Farris Engineering Co.

37 **Reducing Valves**—Bulletin 199 is a 4-page catalog describing the company's line of pressure valves. The valves are well illustrated with wash drawings and sectional drawings on which the various parts are named. The availability of special designs is explained and examples of special types are shown. One section "When You Design," tells what type of information would be helpful in assisting the company in working out a problem. A list of various bulletins available is presented on the back page of the folder. A. W. Cash Valve Mfg. Corp.

38 **Flexible Pipe Joints**—A description of flexible joints for use wherever a flexible or swing pipe joint is required for conveying steam, compressed air, oil, gasoline and other fluids under high or low pressure, are described in this 4-page bulletin. Descriptions of size and dimensioned drawings are shown. Installations of the joints in such applications as vulcanizers, platen presses and locomotive blower lines are given. Flexo Supply Co.

PACKING

39 **Packing Rings**—This new 4-page bulletin, Form A-909, presents complete information on the company's "Vee-Flex" packing rings. Reasons for and advantages of the ring's design are outlined and excellent line drawings show methods of (a) measuring a stuffing box and (b) the completed packing installation. A schedule of ring sizes is included. Raybestos-Manhattan, Inc.

40 **Packings Catalog**—As a convenient guide to its line of mechanical packings, this company has just issued a 20-page condensed catalog, PC-100. The catalog, printed in two colors, contains information on service applications as well as construction and performance features of the most widely used packings in the line. The catalog also contains the well-known "ABC Chart for Palmetto Self-Lubricating Packings." In addition to many other features the catalog presents 42 interesting illustrations. Greene, Tweed & Co.

41 **Packings Bulletin**—This 4-page bulletin describes and illustrates several types of the company's mechanically floating packing. Among the types described are: inside split-case packing, inside cut packing, split flange, marine packing and cups and flanges. Each of these types is well illustrated. Information on how to order metal packing is included. Harper Packing Co., Inc.

MISCELLANEOUS

42 **Fuel Oil Heater Handbooks**—This new Bulletin No. 35 completely covers description, operation and construction of the company's line of fuel oil heaters. Included is a handy viscosity-temperature chart which shows at a glance the temperature required to reduce oil to the required vicosity. Other information included in the booklet consists of capacity tables and other handbook data. The Whitlock Manufacturing Co.

43 **Vacuum Cleaners**—Two new four-page bulletins on vacuum cleaners for boilers and furnaces have just been issued. Bulletin No. 137 describes a stationary vacuum cleaning unit for removing soot from return tubular or sectional boilers and Bulletin No. 117 describes a portable vacuum cleaning unit for furnaces and boilers. Both bulletins contain photographs showing the equipment in action, with sectional diagrams and drawings of the cleaners. Furnace cleaner specifications are also given. The Spencer Turbine Co.

44 **Condensate Return Units**—The steam economy obtained by the installation and use of these lifting and pumping units is portrayed in this new 4-page Bulletin 10-46. A full page table of capacity and dimension data is an outstanding feature of the catalog. Construction and performance of the unit and a set of specifications complete the units' description. The back page of the folder tells about application of the units and gives installation diagram. Sterling Engineering and Manufacturing Corp.

45 **Hot Process Water Softening**—A description of the complete hot lime and soda process water softener of this company's system is described in this bulletin. First is presented a list of units (in the sequence of their location in the cycle of operations) and the functions of these units are described briefly. Positive control of chemical feed described as "the heart of the process." receives detailed treatment. A 2-page illustration presents an excellent drawing of the general assembly of the company's water softening plant. All major plants in the system are numbered and an accompanying list names these parts. Sectional views and detailed descriptions of various parts of the system follow. Typical installations are pictured. The American Water Softener Co.

46 **Masonry Saws**—An 8-page folder describes this company's masonry saws. Described is a newly designed product. The saw is pictured completely assembled and smaller illustrations show parts of the unit. A check list of features tells about the absolute elimination of free dust, the

(Continued on page 166)

Amberlite-treated cooling water prevents scale formation in heat exchangers

In the giant refining industry, scale-forming ions are being removed from the cooling water for heat exchangers . . . to prevent the formation of efficiency-reducing deposits. The AMBERLITE Ion Exchange Resins do the job!

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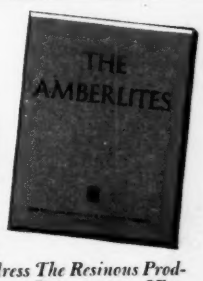

Our booklet "THE AMBERLITES" *suggests many applications for these time-tested Ion Exchange Resins—some applications already commercially established, others pointing the way to new fields of investigations. For your copy of this booklet, address The Resinous Products & Chemical Company, Department CE-8, Washington Square, Philadelphia 5, Pa.*

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Rock-bottom service and maintenance costs are the usual experience with Fairbanks-Morse Diesels.

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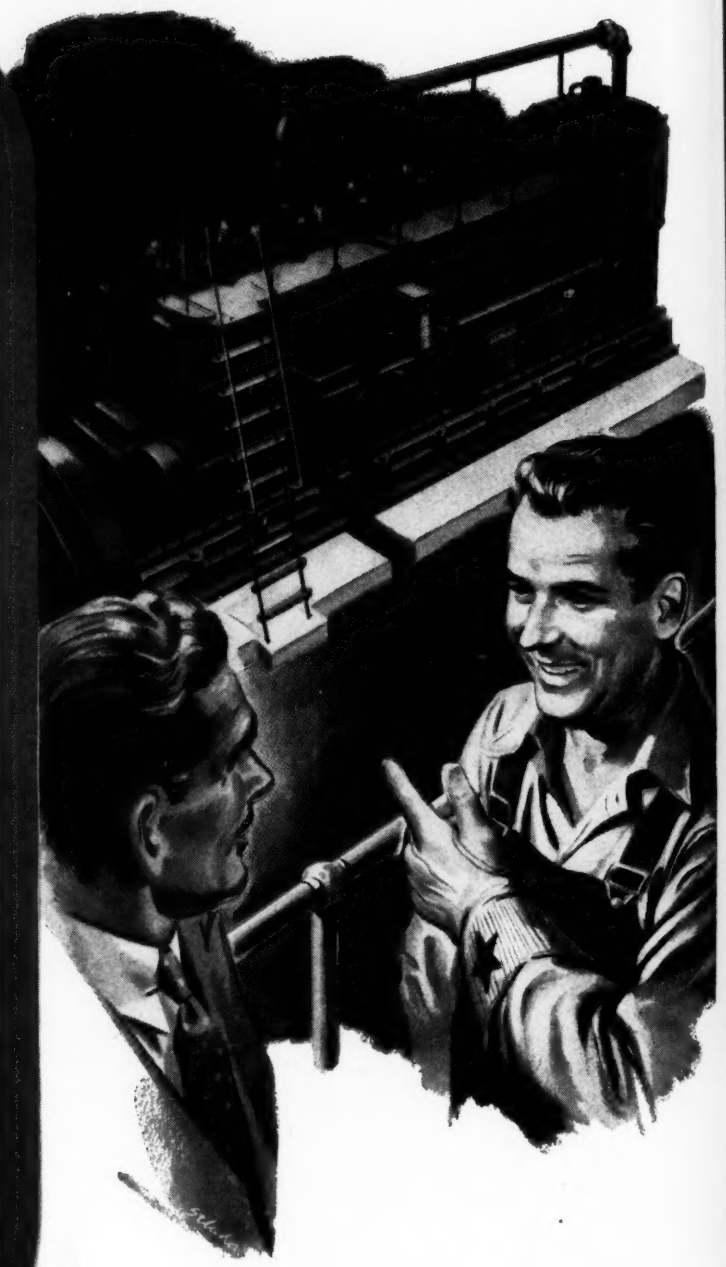

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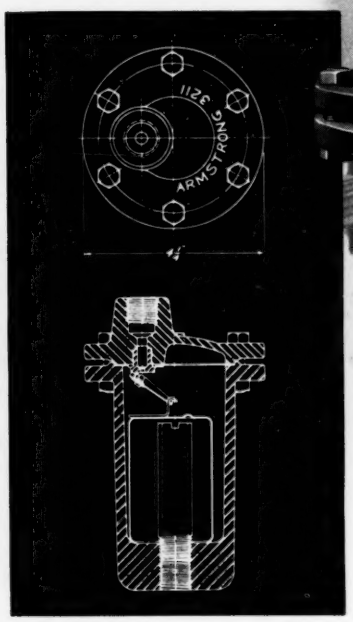
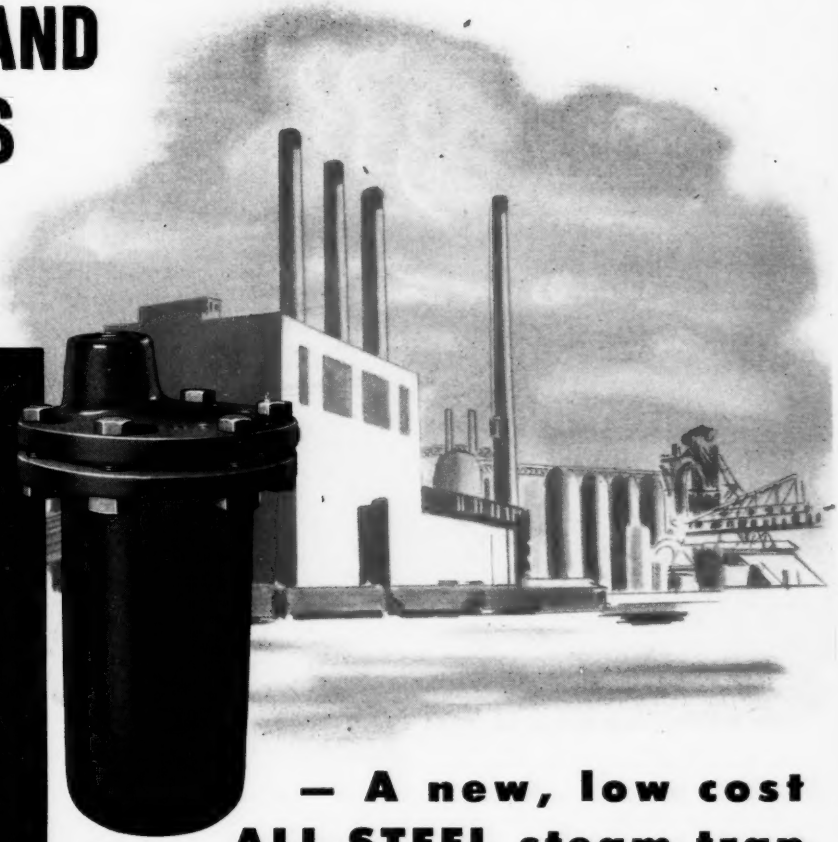
GOOD NEWS for Engineers

in POWER AND PROCESS PLANTS





— A new, low cost ALL-STEEL steam trap

THE NEW Armstrong No. 3211 *forged steel* trap is designed and built to meet the needs of engineers in power plants . . . steel mills . . . process plants for a small size, moderately priced, high quality steam trap. *It's tough* — the forged steel body will withstand hard knocks that would shatter ordinary cast iron traps. *It's safe!* — no danger of the body weakening under high pressure when exposed to fire. Inside, it has the same *all-stainless steel* operating mechanism that's used in Armstrong traps built for pressures up to 1500 p.s.i!

This new trap is now in production in the Armstrong factory. If you are in need of traps of this type, see your local Armstrong representative at once. If it is an urgent matter, write, phone, or wire ARMSTRONG MACHINE WORKS, 810 Maple St., Three Rivers, Michigan.

QUICK FACTS

- SMALL SIZE—Height, 7"; diameter, 4¼". ½" pipe connections.
- BIG CAPACITY—Up to 900 lbs. per hour continuous discharge capacity, depending on pressure.
- PRESSURE—Suitable for operating pressures up to 250 p.s.i. Body is actually built to withstand much higher pressures.
- ORDERING—List price, $14.00. Specify operating pressure.

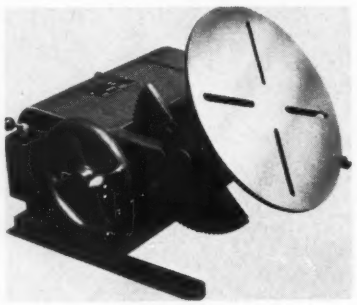
ARMSTRONG *Inverted Bucket* **STEAM TRAPS**

Over a Million in Use . . . For Power . . . Process . . . Heating

NEW EQUIPMENT NEWS

Use the coupon below when you want further information on the equipment described on this page and following pages. Write the identifying letter or letters in the space provided, clip the coupon and send it to Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Illinois.

A Bench Model Positioner A power-operated bench model positioner for work weighing 100 lb or less is an answer to increased demands for a faster, more efficient tool for positioning small work. It is announced by Ransome Machinery Co. Built to handle small units, the Model 1-P is a versatile machine that facilitates welding, assembling, repair-



ing, grinding, hard surfacing, and similar operations for positioning the work to the best advantage for the operator. Work may be tilted to 135 deg and locks in any position at any degree of tilt. It may also be revolved 360 deg by a ⅛ hp single phase reversible motor. A disengaging clutch permits free wheeling when desired. Lever-operated vari-drive pulley permits a speed range from 0.21 to 5 rpm.

B Arc Positioner A new service which provides for a greater mobility and a decreasing time-loss factor for users of the latest automatic process of shielded metallic arc welding was recently announced by Mark F. Gouran, Welding Engineer.

This new service has already proved eminently successful in its initial applications to welding jobs that were complex enough in nature to test the service of this fixture in overcoming time-loss, lack of mobility and low efficiency factors.

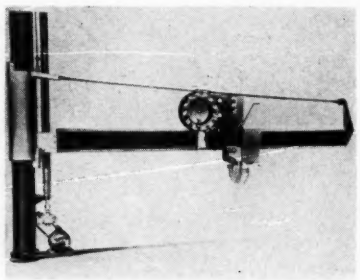
The very name of this fixture—the "Arc Positioner"— befits its versatility of operation, for it is comprised of an automatic shielded arc welding head, traveling on a beam that encompasses a vertical zone of eight feet, with the assembly rotating around a fixed axis to a minimum radius of 20 ft.

As is the case in many similar projects where new techniques are devised, the "Arc Positioner" is a facility that augments the proved efficiency of automatic arc welding. This "Arc Positioner" is manufactured in three standard sizes, providing a 10, 15 and 20-ft horizontal arc travel.

The traveling assembly is the "Lincolnweld" head and carriage manufactured by The Lincoln Electric Co., Cleveland, Ohio, world's largest manufacturer of electric arc welding equipment.

The head travels on the beam to lengths, as stated above, of 10, 15 and 20 ft, while the vertical operation of the head, which is powered by a motor-driven adjustment on the beam, covers an operating zone from the floor upwards to a height of eight feet.

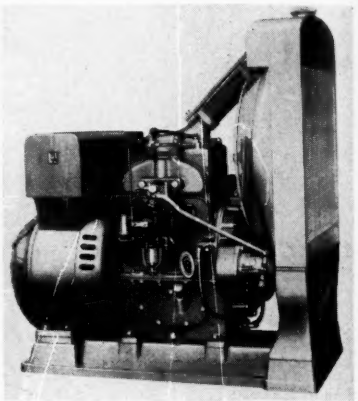
The vertical adjustment of the beam is accomplished at a rate of 36 inches



per minute and permits inching the beam up or down to obtain the exact hight for any particular welding operation. The beam, in its horizontal applications, may be swung manually 360 degrees about its axis, varying in radii according to the length of the beam. "Arc Positioners" of larger capacities are designed and constructed on custom-built jobs only.

C Electric Plant From Universal Motor Co. comes the announcement of new control equipment for their popular two cylinder electric light plant. These controls are the fully automatic type so the power plant starts any time a load is placed on the line and continues to operate until the last load is turned off.

The new Universal Model 2500-BA



is now offered with these new controls. Model 2500-BA provides 2000-2500 watts, 115 v, single phase, 60 cycle, alternating current, and it is powered by two cylinder, four cycle, water-cooled gasoline engine. The entire unit is of compact construction, and all of the controls are conveniently mounted in a metal cabinet just above the generator.

These new controls are unique in that they require no special attention, no adjustments of any nature, and no complicated wiring connections. The controls operate quietly, and the relays are of the quick-make, quick-break construction to give instantaneous action under all climatic conditions.

D New Sealed Ignitron A new 400-amp sealed ignitron, Type GL-507, which is part of a line of tubes for high-power rectifier service, has been made available by the Tube Division of General Electric Co. Electronics Department.

The GL-507, largest sealed ignitron in its class, with an average current rating of 400 amps, represents an extension of the line which up to now has included tubes with 100-amp and 200-amp current rating.

Its primary application is for use in power rectifiers for mining, electrochemical, transportation, steel, and many other industries, he said.

A mercury-pool tube of permanently sealed steel construction, the new ignitron has two ignitors, only one of which is used at a time. Efficient operation results from the GL-507's low arc loss. Phase control of the firing of the ig-

MAY, 1947

POWER PLANT ENGINEERING

53 W. Jackson Blvd., Chicago 4, Illinois

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No business can afford wasteful, costly production-lowering valve leakage. That's why it's always *good* business to maintain a regular check on valves, to make sure they are *tight* and in proper working order . . . . Maintenance men the nation over prefer Lunkenheimer Valves. They know from experience that these *quality-built* valves serve longer and better on the job—are easier to keep tight with a minimum of time, labor, and expense.

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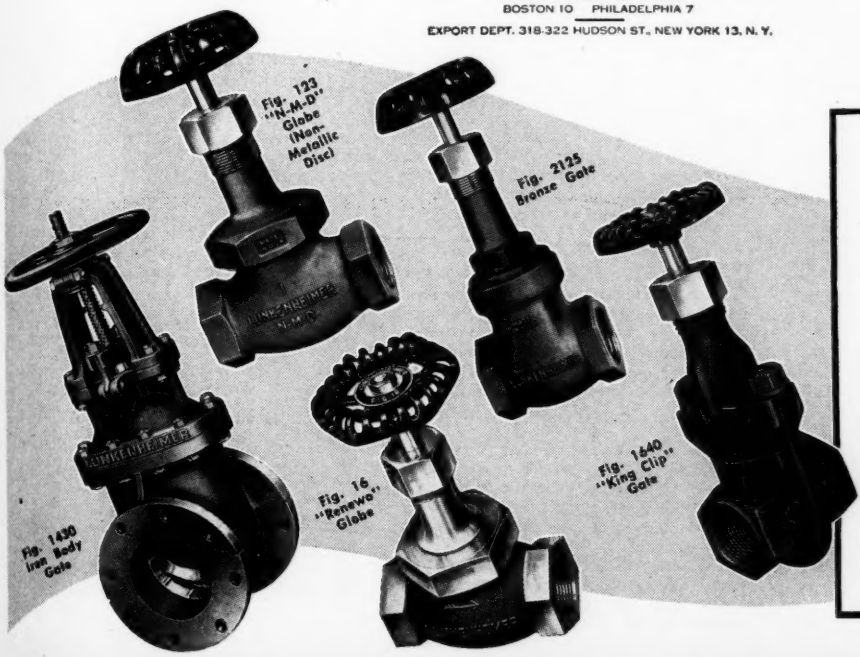
Fig. 123 "N-M-D" Globe (Non-Metallic Disc)
Fig. 2125 Bronze Gate
Fig. 1430 Iron Body Gate
Fig. 16 "Renewo" Globe
Fig. 1640 "King Clip" Gate

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BRONZE, IRON, STEEL AND CORROSION RESISTANT ALLOY VALVES, 125 TO 2500 LB. S. P.;
BOILER MOUNTINGS, LUBRICATING DEVICES, AIRCRAFT FITTINGS

nitor permits voltage control of the rectified output. Excitation of a small auxiliary anode stabilizes the cathode spot for very small anode currents.

The GL-507 is over two feet tall and weighs about 100 lb. According to General Electric tube engineers its design provides the control characteristics of the thyratron, the versatility of the half wave tube in circuit application work, and the very high emission capacity of the mercury pool.

E Electric Soldering Tool The Thermo-Grip Soldering Tool, manufactured by Ideal Industries, Inc., has been completely redesigned.

Operating on the resistance heating principle, the same as the previous models, the new unit heats 20 per cent faster, has thumb switch for close heat control, is modern in design, lightweight, compact, portable and can be used for long periods of time without overheating.

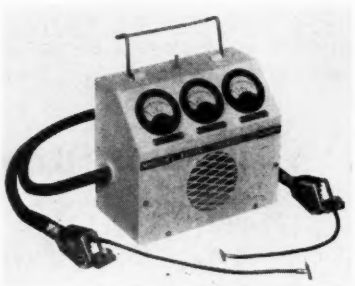
Built to industrial standards, the complete unit includes a transformer of power unit and a soldering tool that operates like a pair of "pliers." Holding

the work with the "Plier" tool completes the transformer secondary circuit and causes the work to heat instantly. No preheating is necessary. Heat is produced between the electrodes of the soldering tool only, thus concentrating it on the exact spot needed. There is no danger of melting nearby joints or burning other parts.

Handles of the "Plier" soldering tool are made of light-weight plastic. Radiating fins isolate the meehanite jaws from the handles to prevent excessive heat condition. The "Plier" can be locked in any position for special applications by tightening screw at hinge. Secondary leads, made of super flexible power cable and insulated with lightweight woven asbestos, are attached to the side of the jaw for easy handling and cooler operation. The "Plier" is intended where work may be held in the jaws and heated—for example, in removing or applying solder lugs, sweating and unsweating copper pipe and fittings, soldering wire joints, etc.

F Battery Tester The Mercury Battery Tester and Desulphater will find demand for use with any make of fast charger that is not equipped with individual cell testing or a high-rate breakdown tester. It is announced by The Mercury Battery Charger Co.

This tester can be taken to the battery and the battery tested accurately without removal. It will no longer be



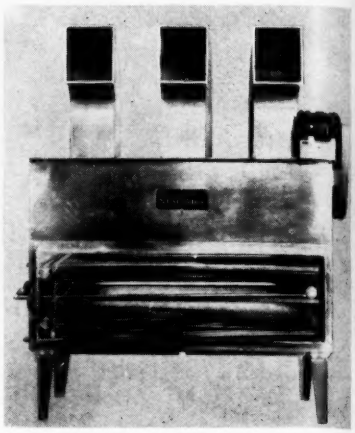
necessary to take the battery to the tester.

Equipped with highest quality jeweled bearings, guaranteed accurate meters, the price of this Tester is only $49.50, f.o.b., Kansas City. Freight allowed in lots of ten or more.

G H.P. Fan Heater The Niagara High Pressure System Fan Heater announced by Niagara Blower Co., uses a dual coil system to obtain complete utilization of both the latent and sensible heat of high pressure steam in heating—eliminating complex secondary piping, reducing stations and accessories. This coil system is installed in a fan heater of standard design in which air is drawn through the heater by centrifugal fans.

The high pressure steam is condensed in a finned coil, the condensate flowing into a trap from which it is admitted to the regenerative vapor coil entering header where it flashes into vapor. Any of the high pressure condensate remaining liquid at this point is drained directly to the final condensate return header by a hairpin bend tube from which this condensate gives off its heat into the air stream.

The vapor condensing coil has its top (or vapor) leg finned and steeply pitched. The lower (or condensate return) leg is relatively flat, leading to the condensate return header in which there is a weir that keeps the liquid

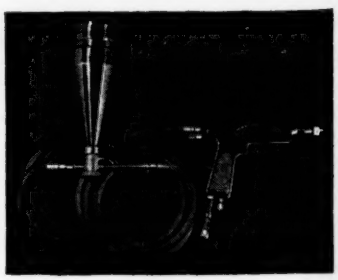


level high in this leg where it is in contact with the coldest portion of the air stream. This sub-cools the condensate below its relative return temperature. The weir has a bleed hole for draining the condensate upon shutdown.

From the vapor coil condensate return header the condensate is withdrawn into the return system to the boiler. Vacuum return is vapor free and fully efficient, returning the condensate evenly and without flashing, at low pressure and temperature.

H Spraywelder A new type of powder metallizing unit, the Colmonoy Spraywelder, has just been announced by Wall Colmonoy Corp.

The spraywelder was developed for use in conjunction with the Colmonoy Sprayweld Process. With this new unit it is possible to combine the advantages of both welding and metallizing procedure. The unit is operated in the first part of the process as a powder metallizing unit to apply a uniform overlay of the hard-facing alloy. It is then used as a conventional welding torch to fuse this sprayed overlay to the base metal to obtain a fusion or molecular bond, identical to that obtained when the same alloy in rod form is applied by acetylene welding.



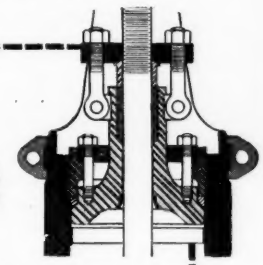
The new unit is simple and dependable. There are only two control valves, both of these being mounted on the gun itself. Once adjusted, the powder flow may be stopped and started at will by pressing or releasing the trigger. The gun is light in weight and perfectly balanced. It may be hand operated, or held in a vise or with an attachment in the tool post of a lathe. Because

MORE COMPACT!

New CRANE *PRESSURE-SEAL BONNET* VALVES

Note comparative dimensions of 1500-Pound Crane Pressure-Seal Steel Gate Valve and of conventional design. Both are 8-inch. In every size, these new valves give you important space-saving advantages. Require less head-room to operate.

HOW THE LEAK-PROOF PRESSURE-SEAL BONNET JOINT OPERATES



Bonnet joint is inside the valve . . . sealed with wedge-shaped seal ring. Fluid pressure in valve automatically keeps bonnet joint tight. No bolts to retain pressure. Leakage is impossible.

NEW PERFECTION IN VALVE DESIGN FOR HIGH PRESSURES AND HIGH TEMPERATURES

New streamlined, simplified construction . . . inside and out . . . saves 40 to 60% weight over conventional valves. Inspection is easier . . . insulation is simplified. New disc and seating arrangements assure highly improved operating efficiency. As developed by Crane, the Pressure-Seal principle brings a whole new era in valve engineering and valve performance.

The Crane Pressure-Seal line includes gate, globe, angle, and automatic stop-check patterns with welding ends. Complete information regarding performance and adaptability to your requirements supplied on request. No obligation . . . call your Crane Branch.

1500-Pound Crane Pressure-Seal Bonnet Globe Valve.

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

EVERYTHING FROM . . .

VALVES • FITTINGS
PIPE • PLUMBING
AND HEATING

CRANE

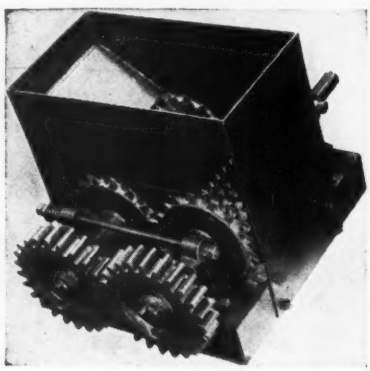
FOR EVERY PIPING SYSTEM

of its design, it may be easily operated in all positions.

While the unit was primarily designed for spraying Colmonoy alloys, it will handle other powdered compositions equally well. The price of the unit is very low, in comparison with its performance.

The Spraywelder unit consists of the gun, all necessary hoses, with connections. The hopper for the powdered metal and the carburetor are combined in a single unit. In addition a panel to hold all the equipment is provided.

J Stoker-Coal Crusher Illustrated crusher, made by Eagle Iron Works, reduces egg and nut coal down to stoker size at the rate of 18 to 25 tons per hour and requires only 5 hp to operate. Normal size of coal produced is ¾ in. but the long-wearing, alloy semi-steel rollers are adjustable to bring size down to nearly ⅜ in. 12 in. diameter by 16 in. rolls



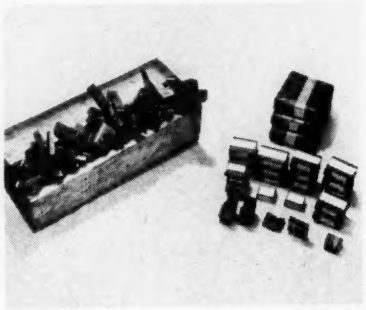
operate normally at 250 rpm—shafts are carried in heavy babbitt lined bearings. One set of bearings is backed with release spring to permit passage of any hard, foreign material without damage to crusher.

Hopper has wide 17 in. by 24 in. opening for easy loading and baffle plates to distribute feed evenly to rolls. Drive may be either V or flat belt—1 15/16 in. pulley shaft has ½ in by ¼ in. keyway for attaching pulley.

K New Electrodes For rapid and economical welding of mild steel in all positions and with alternating-current or either polarity direct-current, straight preferred, the new SW-2 electrode, available in four diameters from 3/16-in to 5/16-in., is announced by the Westinghouse Electric Corp.

SW-2 electrodes were developed in the larger diameters to provide electrodes having the desirable characteristics of the Westinghouse SW electrodes which have been manufactured in diameters of 3/16-in. and below, for a number of years. Welds made with SW-2 meet the requirements of AWS-ASTM specifications for classifications E-6012 and E-6013, but have the very desirable characteristics in respect to flat contours, side wall wash-up, freedom from undercutting, and extreme ease of slag removal, that are obtained with Westinghouse DH electrodes (AWS-ASTM classification E-6020 for flat and horizontal work.)

L Reconditioning & Regrinding Service Illustrated is a shipment of worn threading dies sent to The Mechanical



Arts Co. for application of its new reconditioning and regrinding service. Packaged neatly, at the right in the photo, are the same dies a day or two later, completely reconditioned and ready for return. This is a typical example of the new service which The Mechanical Arts Co. is now offering on a nation-wide basis at about ¼ the cost of replacement.

The work, often arriving as a jumble of dull and worn threading dies, is sorted as received. It is cleaned, reground, carefully reconditioned in all respects. Then it is wrapped in sets, in heavy, waterproof paper, carefully labeled for quick identification, and returned by parcel post or express, or by air is so specified. This service is available on one or any number of dies. The company will send further data and prices on request.

•

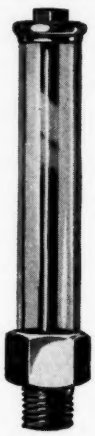
M Neon-Glow Voltmeter A midget neon-glow meter that indicates a-c or d-c voltage, is immune to mechanical and electrical abuse, and very moderate in cost, the Mini-Volt, is announced by Industrial Devices, Inc.

The Mini-Volt is a simple meter of

practical accuracy for use by repair and maintenance men, electricians, radio servicemen, experimenters and laboratory workers. It is virtually burnout-proof. Housed in a neat bakelite case and provided with a 12-in. flexible test leads with prods, it is rugged enough to be thrown into the tool box or carried in the pocket without danger of damage. Calibrated for use on a-c from 65 to 660 v, with an impedance of approximately ½ megohm, is is operated merely by turning the knob until the neon glow extinguishes, whereupon the voltage is read directly off the scale. For d-c, which is indicated when only one electrode of the neon indicator glows, the reading is multiplied by 1.15.

This handy instrument may be used to check whether lines are 110, 220 etc. It may also be used to indicate blown fuses, and to check overloaded lines by taking readings at various points with the load on. Because of the high impedance value, it may be used to measure plate voltages in radio work and for checking leakage. The neon indicator being guaranteed for 10,000 hours of actual operation, the Mini-Volt can render many years of service.

N Straight Oil Gages Oil-Rite Corp. has announced a line of newly developed Straight Oil Gages. In a simple sturdy construction, they combine unlimited visibility and unbreakable plastic sights.



The gage body is machined from hexagonal bar stock, and a heavy central stem with top cap to support the unbreakable plastic sights provides a very rugged unit. An independent nut locks the unit compressing the gaskets eliminating any chance of leakage.

The gages can be taken apart for cleaning by simply removing the top nut. Full vision from all angles is made possible by the absence of an unnecessary protective cover usually used for glass sight gages.

Standard sizes cover a gage range of 2½ in. to 5 in. and sight diameters of ½ in. - ⅜ in. and ½ in. N.P.T. Gages with special features can also be furnished to suit individual requirements.

O New Oil Filter Featuring a compact, replaceable cartridge with a number of perforated cellulose discs that provide an exceedingly large filtering area, a new oil filter for lubricating oils, fuel oils, cutting compounds, and hydraulic fluids is available for immediate delivery from the Youngstown Miller Co., subsidiary of Walter Kidde & Co., Inc.

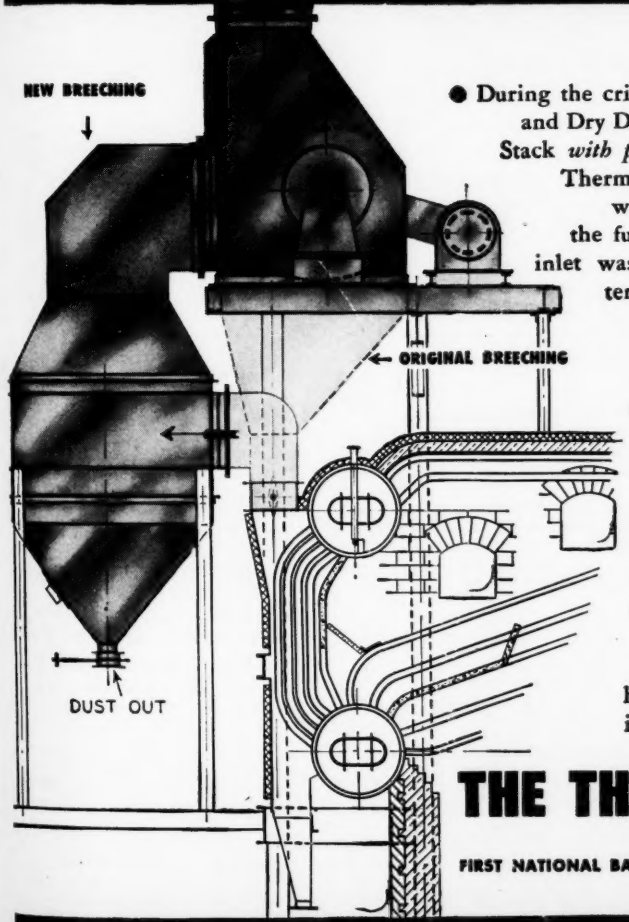
This new replaceable filter cartridge is mounted inside a drawn steel shell that is capable of withstanding high pressures and piped for in-and-out flow, to form a streamlined high liquid velocity unit. Total capacity of the new appliance is 15 lb of sludge—one and one-half times its own weight. The filter element is composed of a cylindrical stack of cellulose discs tightly bound to form a compact cartridge. Tension is maintained by a heavy spring, mounted beneath the container cover, which exerts sufficient pressure to hold the discs compactly and to increase filtering efficiency. Each disc contains a unique pattern of concentric circular holes forming numerous small passageways into the cartridge. These passageways serve to expand the filtering area of the cartridge and provide a large space for trapping sludge and dirt.

Access to the cartridge is provided through the top of the container where

The Federal Shipbuilding and Dry Dock Co.

ENGINEERED for the FUTURE

—Have You?



● During the critical shortage of steel, the Federal Shipbuilding and Dry Dock Company of New Jersey installed a Thermix Stack *with provisions for a dust collector at a future date.* A Thermix Fan Stack with both a side and bottom inlet was used. The side inlet was blanked off for use in the future installation of the dust collector; the bottom inlet was directly connected to the boiler outlet. This temporary breeching, from the boiler to the ID fan, is indicated in the illustration by dotted lines.

Now that steel is available, the Thermix Tubular Dust Collector has been added to the original stack installation. Placing it in operation necessitated only the removal of the duct from boiler to stack and connection of collector to boiler and side inlet of the fan. The original bottom inlet of the fan was then blanked off.

Thermix collectors have the distinct advantage of both flexibility and extremely high collection efficiencies over a wide range.

Call on our project engineers, the Thermix Corporation, for more detailed information on how your plant equipment can be designed and installed to permit future additions.

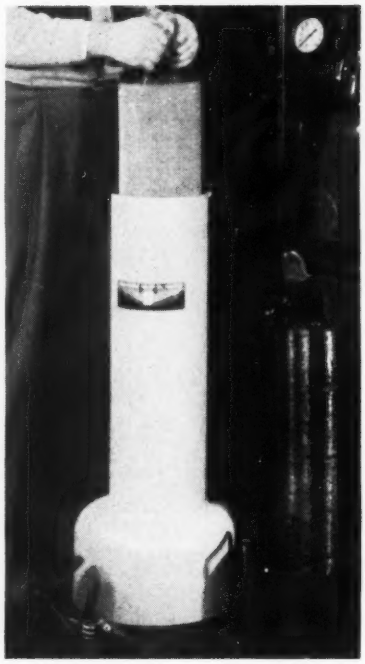
THE THERMIX CORPORATION

Project and Sales Engineers

FIRST NATIONAL BANK BLDG. **GREENWICH, CONN.**

PRAT-DANIEL CORPORATION

EAST PORT CHESTER, CONN.



a single nut holds the lid in place. A wire handle on each cartridge permits easy insertion and removal.

Permanently mounted in the center of the steel container is a perforated tube serving as a clean oil outlet. The filter cartridge is placed over and around this clean oil outlet by means of a longitudinal hole in its center. Oil entering the container can reach the outlet only by passing between the edges of the filter discs. Also, it must travel at least ⅜ in. through the cartridge. Thus, exceptionally fine edge and depth filtration is accomplished with only infrequent interruption for cartridge changes.

Available models of the new oil filter include the ED-10, ED-10H, ED-20, and the ED-20H. The ED-10 is applicable to low viscosity and lightly contaminated oils. For the more viscous and highly contaminated types, the ED-10H is recommended. Both the ED-20 and the ED-20H are dual units —they are composed of two model ED-10 and ED-10H filters respectively, mounted on a common base and connected in parallel by concealed piping. Dual units may be joined in any number to obtain unlimited flow rates.

P Seamless Welding Fittings Ladish Co. has introduced a new line of Controlled Quality Seamless Welding Pipe Fittings.

Already being stocked by authorized distributors in principal centers, the new line consists of 90 deg and 45 deg elbows, 180 deg turn bends, straight and reducing tees, concentric and eccentric reducers, caps, lap joint stub ends, saddles, shaped nipples, crosses and tees in carbon steel, sizes up to 30 in.

Features inherent to the complete line of Ladish Seamless Welding Fittings include uniform wall thickness, accurate circularity, full effective radii, smooth inner walls, machined bevel-ends and improved metal structure.

While designed and manufactured in accordance with recommendations of the American Standards Association and other standards, these fittings have many distinctive features, chief among which is a new tapered tee design. Achieved through scientific metal distribution, the center sections and the crotch are reinforced, the metal tapering off to nominal pipe size at the ends. This new application of the taper principal has resulted in a tee that provides greater strength and durability under severe operating conditions.

In addition to the new tapered design, the tees have a long inner crotch radius which reduces friction and turbulence, thus minimizing pressure loss. Full length branch outlets facilitate the welding operation.

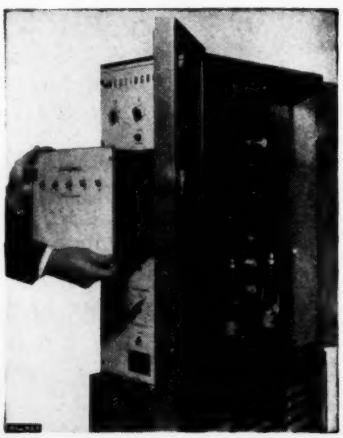
Q Combustion Service Kit Bacharach Industrial Instrument Co. announces two new features for its Fyrite Combustion Service Kit. A metal case with a metal handle and snaps is now standard equipment. An all-metal dial thermometer, 100 to 950 F range, is optional equipment in place of the mercury-in-glass thermometer. The case is standard equipped with bracket for both the dial thermometer and the mercury thermometer.

Advantages claimed for the all metal thermometer include easy readability even in dim light or in "difficult-to-get-at" locations, handling convenience brought about by a unique slip-on-handle, and elimination of the many breakage hazards of the ordinary mercury-in-glass thermometer.

The manufacturer reports that this new kit is now in production and ready for immediate delivery.

R Resistance Welding Control A complete line of nonsynchronous packaged a-c resistance welding controls—known as Weld-O-Timer—is now available from Westinghouse Electric Corp. These new controls represent a departure from past practice in that is is possible to effect hundreds of combinations for sequencing and timing from only four factory wired subassemblies and two supplementary subassemblies.

Made in two frame sizes, the 1200 and the 600, these new Weld-O-Timers are delivered in a unified, factory assembled package. They can be side-mounted to the welder; or, they can be floor mounted next to the welder; or, they can be mounted at any convenient place away from the welder with adjustment controls at the welder. But regardless of how installed, the replacement of a subassembly is a simple matter; loosen two nuts, disconnect the plug connectors, lift out.



The convenient finger tip control speeds production as each job can be quickly set. Voltage regulator tubes are incorporated in timing circuits to give more accurate timing when connected to welder supply circuits. A transparent access door in the 1200 frame size and a metal access door in the 600 frame size protects the control setting against unauthorized tampering. Inspection of subassemblies is simplified in both models through a front access door and in the 1200 frame size a swing-out feature provides access to rear of panel while in the 600 frame size this is accomplished by tilting the subunit panel forward.

Maintenance is reduced by ready accessibility to all parts, by factory assembled subunits, and circuits which means fewer parts.

S Carbide Masonry Drills Extra length, carbide tipped masonry drills for use in deep hole drilling of non-metallic materials, have been standardized by Super Tool Co.

Drills up to 1½ in. in diameter and 20 in. in length can now be supplied "off-the-shelf," according to the announcement.

Heretofore, it has been necessary to produce such masonry drills as special tools on special shop orders. Standardization not only means that users can obtain immediate delivery from stock but at much more favorable prices.

T Concrete Able To Withstand 3000 F. A concrete which easily withstands temperatures as high as 3000 F has been developed by The Babcock & Wilcox Co. Known as "B & W Kaocast," the product is being placed on the market after a long period of successful service trials under severe conditions. Kaocast fills a need for a refractory castable in the construction of industrial furnaces operating at temperatures ranging from the top limit of standard refractory castables up to as high as 3000 F.

Both in service trials and in laboratory tests, the material has shown excellent stability and resistance to spalling (disintegration) under repeated heating and cooling cycles, the announcement stated. Other properties which give Kaocast its durability include its exceedingly small volume

STANDARD ENGINEERS NOTEBOOK

CALOL RPM

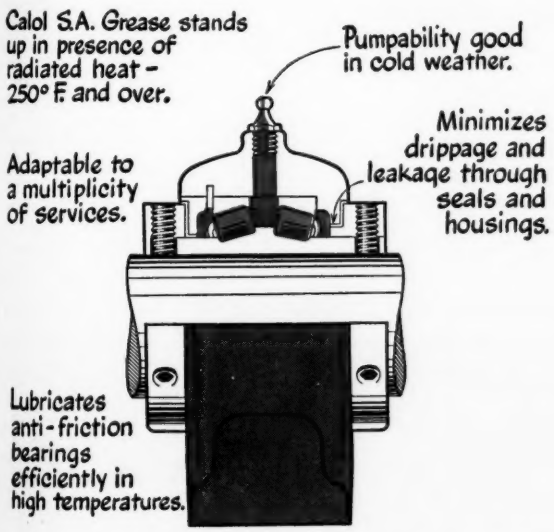
More positive lubrication in high temperatures

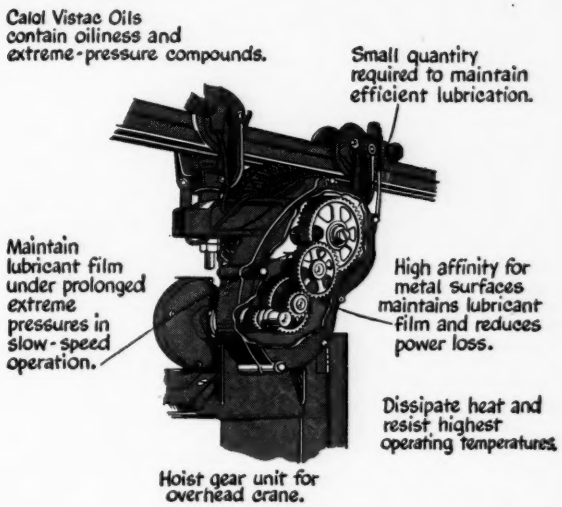
Drippage and leakage from bearings that must operate in high ambient temperatures can be materially reduced by using Calol S. A. Grease.

This special grease is made from a sodium-aluminum base and selected oils with high heat-resistant qualities. In many instances it has provided satisfactory lubrication where bearing temperatures, due to radiated heat, are as high as 250°F. and over. It can be applied easily in all seasons as it has good pumpability in cold weather.

Calol S. A. Grease can be adapted to a great many services in various industries. It was, however, originally developed for anti-friction bearings. Tests in the field and on the Navy Ball Bearing Machine have proved it excellent for low-, medium-, and high-speed bearings of the anti-friction type.

There are three grades of Calol S. A. Grease: No. 00, No. 0 and No. 1. It is packed in 35-, 108- and 420-pound containers.


Calol S.A. Grease stands up in presence of radiated heat – 250° F. and over.
Pumpability good in cold weather.
Adaptable to a multiplicity of services.
Minimizes drippage and leakage through seals and housings.
Lubricates anti-friction bearings efficiently in high temperatures.


Calol Vistac Oils contain oiliness and extreme-pressure compounds.
Small quantity required to maintain efficient lubrication.
Maintain lubricant film under prolonged extreme pressures in slow-speed operation.
High affinity for metal surfaces maintains lubricant film and reduces power loss.
Dissipate heat and resist highest operating temperatures.
Hoist gear unit for overhead crane.

Viscous and tacky oils keep tough film on gears

Heavy duty gears, such as industrial reduction sets, with forced-feed or gravity lubricators, sight-feed cups, bottle- or wick-oilers are safely lubricated with Calol Vistac Oils.

As the name "Vistac" implies, these oils are both viscous and tacky and have a high affinity for metal surfaces. They contain oiliness and extreme-pressure additives and provide a lubricant film of unusual strength. This film resists rupture even on slow-moving gears that develop extreme pressures over a wide area for a relatively long time.

In addition to being outstanding gear lubricants, Calol Vistac Oils are excellent for air hammers, rock drills and other air tools. They rapidly carry away heat, resist high temperatures, stay fluid at low temperatures and atomize quickly. There are six viscosity grades of Calol Vistac Oils:

9X (SAE 10), 14X (SAE 20), 19X (SAE 30), 28X (SAE 40), 36X (SAE 40), 45X (SAE 40).

Trademarks "Calol," "Vistac," Reg. U. S. Pat. Off.

For additional information and the name of your nearest Distributor, write Standard of California, 225 Bush Street, San Francisco 20, Calif.; The California Oil Company, 30 Rockefeller Plaza, New York 20, N. Y.; The California Company, 17th and Stout Streets, Denver 1, Colo.; Standard Oil Company of Texas, El Paso, Texas.

FOR EVERY NEED A STANDARD OF CALIFORNIA JOB-PROVED PRODUCT

change on initial firing, and its lack of shrinkage or expansion under continuous use at high temperatures.

Because its can be either poured into place like ordinary concrete used in construction work, or used as a ramming mixture, Kaocast will effect considerable savings in furnace construction. This is particularly true of furnaces requiring extensive use of special shapes which were formerly made of kiln-fired materials or of refractory plastics. Kaocast can be used either for the quick fabrication of these special shapes, or to form part or all of the furnace lining.

Other applications where Kaocast will cut down construction time and reduce furnace maintenance, include its use as a covering for studs in water-cooled furnace walls and in forming high temperature baffles. Its ability to resist spalling also makes it suitable for use on furnace car tops, which are subjected to repeated heating and cooling cycles. Because its volume change is negligible under high temperatures, Kaocast is ideal for deep patching of spalled or eroded brickwork.

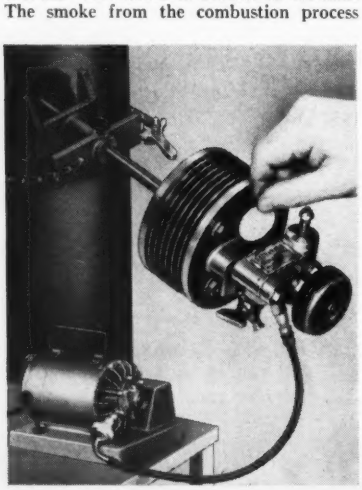
U New Smoke Tester The Bacharach Industrial Instrument Co. announces the development of a new instrument designed primarily for testing density of smoke from the combustion process in oil burning furnaces.

This Bacharach Smoke Tester consists of a sampling unit which is attached to the smoke pipe of the oil burning furnace and a motor driven vacuum pump which may be set at any convenient place near the furnace. A time switch mounted on the motor base automatically stops the operation of the motor after one minute interval.

The flue gas sampling tube of the sampling unit is inserted into the flue pipe through a 7/16 in. hole located between the furnace outlet and the barometric draft regulator. The sampling unit is then attached to the flue pipe by means of an adjustable strap as shown in the illustration. The electric cord of the vacuum pump is plugged into the nearest 110 v a-c outlet and a small filter disc is inserted into the filter holder of the sampling unit. A turn of the handwheel at the end of the sampling unit closes the filter holder and holds the filter disc firmly in position.

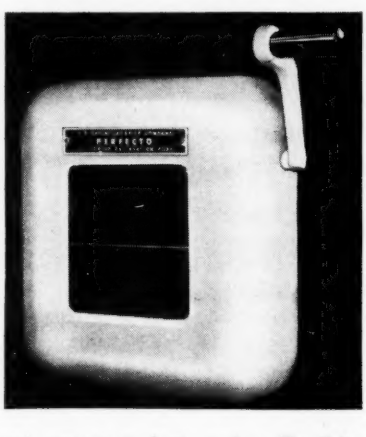
When the lever of the time switch is pushed against its stop, the vacuum pump starts and draws flue gas through the filter disc for one minute at controlled vacuum. The smoke from the combustion process is carried along in the flue gases sampled by the sampling unit and is evenly deposited on the filter disc, thus producing a visual indication of the smokiness of the flame. The exposed area of the filter disc will vary in shade from light gray to black, depending upon the extent to which the flame is smoking.

Immediately after the pump stops, the filter disc is removed from the holder and then compared with the smoke discs on a comparator scale furnished with the instrument. By this matching procedure it is a simple matter to adjust an oil burner to give the highest percentage of CO_2 without objectionable smoke.



V Furnace Observation Port A newly designed, air-cooled observation port for use in all types of industrial furnaces is introduced by the A. P. Green Fire Brick Co. Weighing only 14 lb, it can be easily installed in any new or old furnace wall; common brick, firebrick or steel cased.

The wide angle vision of the Perfecto observation port permits the operator to observe furnace and grate conditions with no disturbance of the firing cycle and without exposure to heat or glare. Simplicity or design, with self closing air-cooled ribbed shutter and divided blue pyrex window, prevents malfunction from furnace heat.



The modern streamlined cover is free from dust-catching ledges or pockets and gives a neat appearance. The observation port is shipped completely assembled in individual cartons with anchor bolts and instructions, ready for easy installation.

W Flow Measuring Instrument The Hastings Instrument Co. is introducing an ultra-sensitive air velocity meter which will measure accurately air velocities as low as five feet per minute. The Air Meter is applicable to the measurement of velocities in ducts, the measurement of wind velocity, the measurement of flow in air and gas lines, and surveys of heating and air conditioning systems. The principle of operation is based on a unique combination of hot-wire and thermopile principles. This arrangement increases the accuracy of the instrument by minimizing the errors due to air temperature variations.

The pickup element is a noble-metal thermopile which is placed in the air stream. Alternate junctions are arranged to have much greater cooling than the adjacent junctions which are heated by passing alternating current through the wire.

This instrument operates from 110 v a-c power that may be obtained either from the house wiring or from a portable power pack that is battery operated. The instrument may be adapted for remote indication of velocity or flow of air or other gases.

The standard range of the instrument is from 0 to 2000 fpm. Fifty feet per minute is approximately 20 per cent of full scale. Velocities as low as a few feet per minute can be measured.

X Fire Equipment An unlimited supply of extinguishing agent is provided as water fog with the new Underwriters'-approved fire equipment in production by Bowser, Inc. The unit, Fig. 1030, connects directly to a water line. A swing joint mounting makes it possible for the fixture to turn in alignment with direction of the hose pull. A 50-ft length of ¾ in. high pressure hose is racked in figure 8 position for fast removal without kinking.

It is pointed out that the unit is unusual because the nozzle supplies finely atomized water with medium pressure as normally provided by city water systems. Laboratory tests report a 20 ft fog projection at 50 psi nozzle pressure with a gallonage discharge of 15.9 per minute.

Y Carbon Disperser For Diesels A new fast-action, hard-carbon dispersing agent for the Diesel power field which dissolves and disperses carbon deposits, varnish, lacquer and sludges, has been developed and marketed by Coburn Mfg. Co. This new solvent removes all petroleum residues, leaving the metal clean and ready to reuse. Time and labor of scraping and buffing are eliminated. Directions for use are simple: submerge in warm solvent, agitate, and flush with warm water. The solvent is used with an agitator and leaves a protective film against rust.

Under the trade name, Industrial Lix-Sol, this new solvent is expected to become invaluable in all industries where carbon and other petroleum residues present a maintenance problem. It is especially useful in all overhaul operations on Diesel, gasoline and internal combustion engines working parts, turbines, high-pressure jets, carburetors, compressors, oil lines, hydraulic systems and regulating valves.

Why users *repeat* with COPES FLOWMATIC

FOUR out of ten COPES Flowmatics in service today represent repeat orders from satisfied users. Highly flexible, the Flowmatic system permits easy adaptation to any piping conditions or operating preferences. Strikingly simple, the two-element COPES is easily kept at peak efficiency by the boiler operators. In most cases, not even initial start-up requires "expert" servicing. And control is dependably accurate year after year.

As a case in point, the charts at the right were recorded five years after the 875-psi, 875-F boiler was placed under Flowmatic control. There is a load range of from 250,000 to 410,000 pounds per hour, with water level held within limits of plus-or-minus one-half inch. Obtained with only routine attention from the operators, this close control has brought a repeat order for COPES Flowmatic for a duplicating boiler being erected.

A performance report on COPES Flowmatic in this and two other stations of the same utility system is given in Bulletin 469. Write for it.

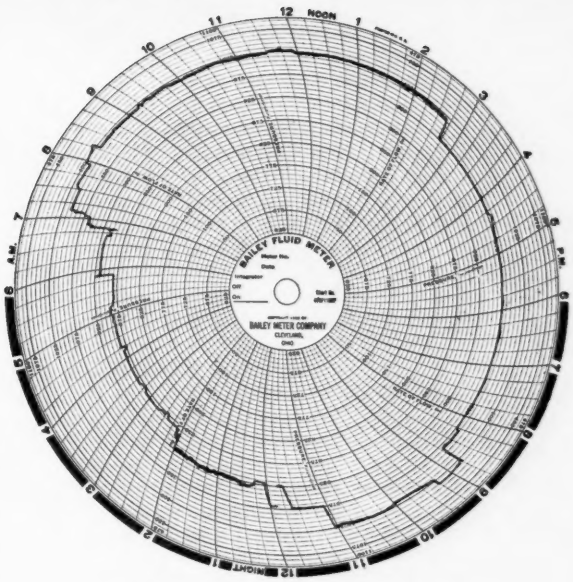
NORTHERN EQUIPMENT COMPANY

572 GROVE DRIVE, ERIE, PENNSYLVANIA

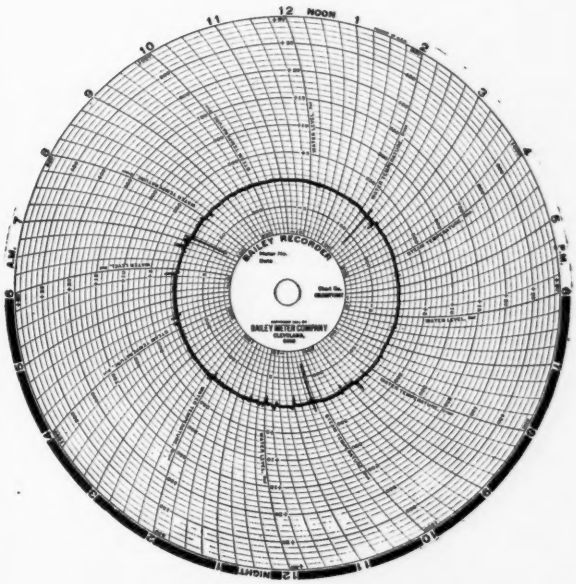
Feed Water Regulators, Pump Governors, Differential Valves, Liquid Level Controls, Reducing Valves and Desuperheaters

BRANCH PLANTS: Canada, England, France

Representatives Everywhere



Load range is 160,000 pounds per hour



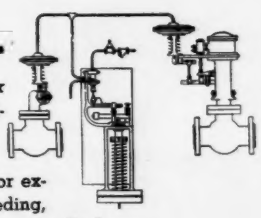
Level is stabilized within $\pm$ ½-inch

★ GET CLOSER LEVEL CONTROL WITH COPES FLOWMATIC

DESUPERHEATER...

Here's a desuperheater every bit as effective on light loads as at full capacity. No water dribbles into the steam line. There is complete atomization of the cooling water from zero to full load because the opening of the spray nozzle—not the pressure drop across it—is varied with steam temperature. A self-contained unit, as *dependable* as the COPES Feed Water Regulator. Write for Bulletin 405-A.

MASTER CONTROL...



Remote control of reduced water or steam pressures, with single or multiple pressure reducing stations, is *dependably* accurate with the COPES Master Control. Adapted for excess pressure control in boiler feeding, where one or more turbine-driven pumps discharge into a common water header. Details on request.

Tops FOR TOP PRESSURES

On steam lines where pressures go as high as 1500 psi, and temperatures up to 900° F. are encountered, steam traps must be rugged . . . and *efficient!*

That's why so many public utilities and other high pressure steam plants are installing Yarway Integral Strainer Impulse Steam Traps. First cousin to the famous standard Yarway Impulse Steam Trap, the integral strainer trap has been developed especially to meet high pressure trapping requirements.

It has ample condensate capacity when system is being "warmed up." Yet it will handle relatively small amounts of condensate efficiently without losing prime. The valve closes positively in the presence of dry or superheated steam.

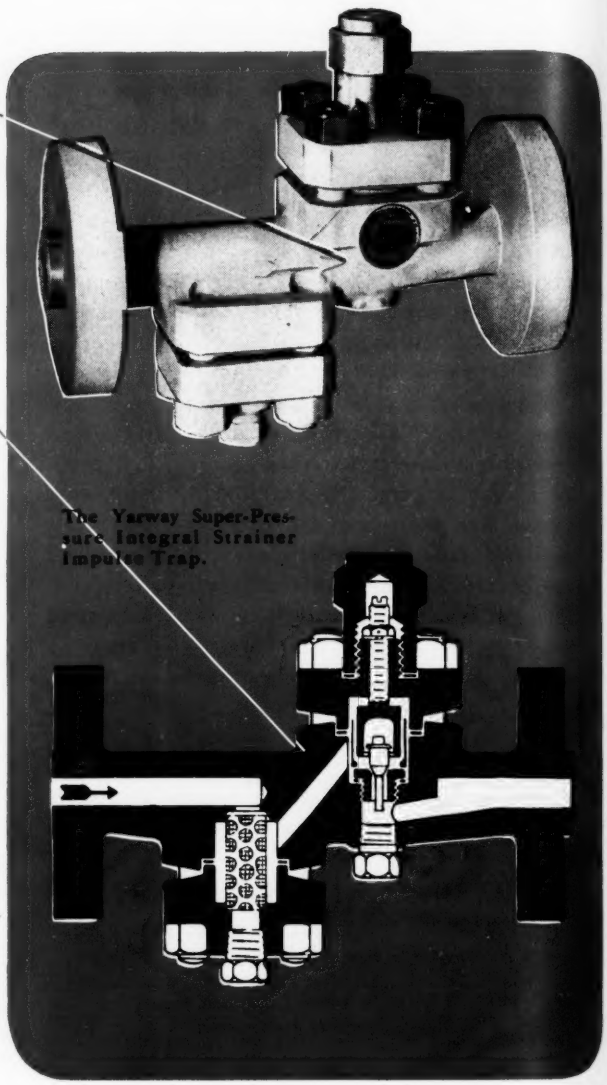
It is a fraction of the size and weight of other type traps designed for the same service—saving space simplifying installation and requiring no supports.

It is suitable for all pressures within a wide range without change of valve or seat.

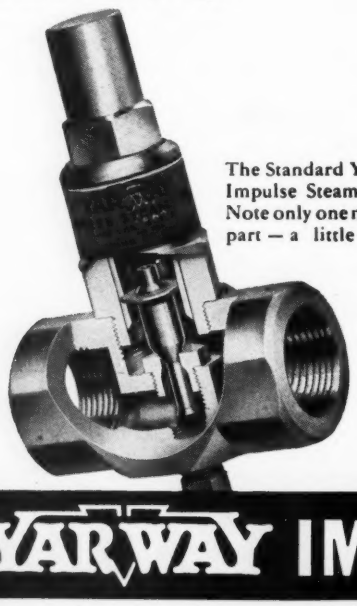
It has the same simplicity of design as does the standard Impulse Trap shown below—only one moving part, the same little valve.

Its integral strainer protects trap against scale and rust in the piping system.

Available with flanged or socket weld connections. Write for Bulletin T-1739.



The Yarway Super-Pressure Integral Strainer Impulse Trap.



The Standard Yarway Impulse Steam Trap. Note only one moving part — a little valve.

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YARWAY IMPULSE STEAM TRAP

WHAT LEADERS SAY

Responsibilities of Business Papers

By EARL L. SHANER

EVER since the first business paper was established in the United States in 1795, the business press has been pacing American business through its various stages of development. Today its 1900 publications are so sensitively attuned to the requirements of business personnel that it would be difficult to find any important group of individuals with common business interests that is not served adequately by one or more important periodicals.

These publications have the common purpose of helping their readers to solve problems relating to their business. The record of the scope and character of this assistance and of the measure of its beneficial results constitutes one of the brightest chapters in the rise of American business to its present high position.

The business press provides a highly efficient medium for the prompt interchange of valuable information. If a man builds a better mouse trap than his competitor, the world need not beat a path to his door; business papers will herald the discovery and disseminate pertinent information regarding it to interested readers throughout the nation within a period of days. Every significant invention and every improvement in method is reported promptly by the business press to individuals who can put the information to work profitably immediately. The service which business papers are rendering through their editorial and advertising pages in reducing to a minimum the time lag between the birth of "know-how" and its profitable application in business is a most important factor in the rapid development of the American economic system.

Most Important Role: Educators to Business

It is almost impossible to exaggerate the importance of the educational function of business papers. A person holding a responsible position in business has access to publications which serve as current text books on any business subject in which he may be interested. This type of text book has the great advantage of being automatically self correcting and up-to-date. It is more realistically balanced as to theory and practice than any orthodox text book of the classroom can be. The avidity with which leaders in industry, trade and the professions pursue their adult education through business papers is indicated by the millions of copies of reprints of outstanding articles demanded annually by business paper readers for file and reference.

Crystallizers of Business Opinion

Business periodicals also render yeoman service to business by helping to crystallize contemporary thinking and to translate it into construction action. Time and time again an alert business paper editor, sensing the faint smoldering of sentiment in favor of a constructive movement in his field, has fanned it into flame and carried it through to achievement.

From this sketchy picture of business paper functioning, it must be obvious that the business press is an integral part of American business and that it has played an important role in the business developments that carried this nation to its present position of world leadership.

Progressive Responsibility of Business Papers

While business paper publishers naturally are proud of their record in this respect, it is impossible to find a progressive publisher who is satisfied with the contributions his publications have made to date. Many business paper publishers and editors feel that everything that has been accomplished thus far has been probationary experience—a conditioning for greater responsibilities that lie ahead.

World-shaking events of the past few years have convinced many in the business paper field that the real job of the business press is just beginning. We have paced American business to a point where it is the envy of the world. Ahead lies the task of demonstrating that this great economic system that we have helped to develop can be properly harnessed and controlled so that it can serve humanity more effectively and more reliably.

This point has been impressed upon me with particular emphasis because, as the result of a recent trip on which I was privileged to talk with well-informed persons in the wartorn sections of Europe and Asia, I have a fair idea of how a majority of the people of the world look upon the United States and its economy.

Wanted: A Stable Economy

They admire tremendously the material achievements of our nation. They are convinced that it was our industrial genius and power that won the war. They acclaim the United States as the hope of the postwar world. They look to us for leadership and for help in their gigantic tasks of rehabilitation.

But while they praise our economic system which was so important in waging of war, they have doubts as to whether or not we can control it in peace. They are convinced that if we cannot shave off the peaks and fill in the valleys of our economic cycle to better effect than in the past, we will go into another tailspin of depression which not only will prevent our nation from enacting its noble role of leadership and assistance in the postwar world but probably will condemn most of the world to chaos.

Thus destiny has set the stage so that a stable economy in the United States

(*Continued on page 130*)

Earl L. Shaner, editor-in-chief of STEEL, was born in 1890 at Olean, N.Y. After attending public schools in that city he took a course in railway mechanical engineering at Purdue University where he was graduated in 1914. Following a number of years in the motive power department of the Pennsylvania Railroad, he joined the Penton Publishing Co., working in editorial capacities on several of its publications. From 1917 to 1919 he served in the infantry in France and in the army of occupation in Germany in World War I. Upon returning to the Penton Company he served successively as engineering editor, managing editor and editor of *Iron Trade Review*, the name of which was changed to STEEL in 1930. He is now editor-in-chief of that publication.

In 1937, Mr. Shaner became president and treasurer of the Penton Publishing Co., which position he now holds. He is a past president of the National Conference of Business Paper Editors, past president and past chairman of the Associated Business Papers Inc. and has served as a director of the National Publishers Association.

Last May, Mr. Shaner accompanied a mission around the world as a member of the United States Reparations Commission, studying and reporting on industrial conditions in the Far East and in Europe. He served as iron and steel consultant on this mission. The conclusions he drew from his observations on this mission, presented here, are drawn from his address before a recent annual meeting of the National Publishers Association in New York.

Nine Years' Operating Experience

By D. S. SNELL and L. P. GROBEL

Turbine-Generator Engineering Division, General Electric Company

ONE OF THE EARLIEST hydrogen cooled generators built for commercial service, a 25,000-kw, 3600-rpm unit installed at Dayton, Ohio, was placed in operation in 1937. Since that date the General Electric Company has built and placed in service a total of 108 hydrogen cooled generators, of both 3600 and 1800 rpm types, with a combined output of over 4½ million kw. The operation of these machines has been highly successful, and has fully demonstrated the practicability of hydrogen cooling for turbine generators. It seems appropriate at this time, in view of the present widespread acceptance of this type of generator to review the experience gained in the operation of a large number of these units, showing how the expected benefits from hydrogen cooling have been realized, recounting some of the operating problems encountered and the measures taken in meeting them, and, finally to describe recent changes in the design of the hydrogen cooled generator which this operating experience has shown to be desirable. The first section of this article will deal with operating experience with the machines in service, while the second section will describe recent developments in the design of this type of generator.

Some twenty odd years ago a number of engineers had the foresight to engage in the development of hydrogen cooled turbine generators. Until about 15 years ago, however, many operating engineers were skeptical about the safety of hydrogen as a cooling medium since its use presented a number of constructional and operating problems. These problems, however were attacked one by one until now they are all successfully solved.

D. S. Snell

Lloyd P. Grobel

This article by Messrs. Snell and Grobel recounts the experience of the General Electric Co. in the manufacture and use of hydrogen cooled generators over a period of nine years. It gives a complete account of the operating experience of the General Electric Co. with the machines in service and describes recent developments in the design of this type of generator. The article was too long to present in one issue so we have divided it into two parts. The first part deals with the history and general aspects of hydrogen cooling while the second part to be presented in a subsequent issue will deal with operating experience and modern developments in design.

A word about the authors. L. P. Grobel received the degree of B.S. in Mechanical Engineering from the University of Minnesota in 1924. After two years on the test course at the General Electric Co. at Schenectady he worked in the Research Laboratory until 1937. At that time he transferred to the Turbine-Generator Engineering Department where he has been employed in mechanical development and design. He is co-author of a paper on rotating shaft vibration.

D. S. Snell is a graduate of Union College with the degrees of B. S. in Electrical Engineering (1919) and M.S. in Electrical Engineering (1921). Following his graduation he served a year as instructor in Electrical Engineering at Union College, leaving in 1922 to enter the General Electric Co. in the Engineering General Department. After two years in this department he transferred to the Turbine-Generator Engineering Division where he has since been employed in development and design work. He is the author and co-author of a number of papers and articles on hydrogen cooled generators and other technical subjects. He is a member of the A.I.E.E.

Generators in Service

In Figs. 1 and 2 are shown the number and total capacity of General Electric hydrogen cooled generators of 2-pole and 4-pole design, respectively, which have been placed in operation from 1937 to October, 1946. In the 2-pole, 3600-rpm type, the generators installed are shown to range in size from 18,750 kva to 81,250 kva at 0.8 pf, while in the 4-pole, 1800-rpm type, the sizes range from 43,778 kva at 0.9 pf to 176,470 kva at 0.85 pf. With the exception of the largest unit listed, all generators have been built with internal fans. The 176,470 kva generator is ventilated with four motor-driven fans located in the top of the generator casing. A number of the generators in service are operated as cross compound or vertical compound generating units; with some of these the generator casings are connected together so that both generators operate at a common hydrogen pressure; in most cases, however, the hydrogen systems of the two generators are independent of each other. Four hydrogen cooled generators have been built for foreign service, one a 62,500-kva, 3000-rpm unit having been placed in service in Buenos Aires in 1941, while three 31,250-kva, 3000-rpm units were shipped to Soviet Russia in 1945. Four 37,500-kva, 3600-rpm hydrogen cooled generators were supplied with the four "floating power plants" built for the War Production Board during World War II. These plants were used to supply power to river and seacoast cities both here and abroad where the normal sources of electric power were inadequate or unavailable.

Operating Benefits with Hydrogen Cooling

The use of hydrogen cooling for generators was initially advocated for three principal reasons:

(1) Improved efficiency, due to virtual elimination of the windage losses.

(2) Greater output per pound of material and/or reduced operating temperatures, due to the superior cooling properties of hydrogen.

(3) Reduced maintenance, due to the exclusion of dirt and moisture from the generator casing, free-

With Hydrogen-Cooled Generators

Part I. Earliest hydrogen-cooled generators . . . Number of units in service . . . Reasons for using hydrogen cooling; operating benefits, effect on efficiency . . . Increased output per pound of material . . . Effect on operating temperatures . . . Reduced Maintenance . . . Hydrogen Consumption . . . Use of Hydrogen gas at Higher pressures . . . Effect of Moisture . . . Air and Hydrogen

dom from corona damage, and absence of the fire hazard.

The extent to which these several benefits have been realized is indicated in the following:

INCREASED EFFICIENCY—The full load efficiency of the hydrogen-cooled generator is from 0.6 to 1 per cent better than that of an air-cooled generator of equal rating. At fractional loads (since the reduction in windage loss is constant) the improvement in efficiency is considerably greater. The savings due to increased efficiency make hydrogen cooling economical at present for generators in practically all sizes above 15,000 kw at 3600 rpm, and above 40,000 kw at 1800 rpm. The saving with hydrogen cooling for a 15,000 kw unit, assuming power cost at 0.2 cents per kwh amounts to approximately $1900 a year; for a 50,000 kw unit, about $6000. For the generating capacity indicated in Figs. 1 and 2, the total coal saving effected by the use of hydrogen cooling instead of air, for the time these units have been in operation, is estimated at approximately 600,000 tons.

The superior cooling properties of hydrogen relative to air permit the hydrogen cooled generator to operate with greater current densities in the armature and field windings than are possible with air cooling, for the same temperature rises of the windings, thus permitting an increase in output per pound of active material of approximately 20 per cent. This fact, together with improvements in generator design, have more than doubled the limit of output of self-ventilated generators during the past nine years. Up to 1937 the largest air cooled generator at 3600 rpm built by General Electric was one of 50,000 kva and was ventilated with external fans. At present a hydrogen cooled generator of 111,700 kva at 3600 rpm, ventilated with internal fans, is being built by this company. In the 1800 rpm type the largest self-ventilated generator with air cooling, built by General Electric, was one of 62,500 kva. With hydrogen cooling, self-ventilated units of 125,000 and 176,000 kva at 1800 rpm are now being built.

Lower Operating Temperatures

Although the hydrogen cooled generator is normally designed for operation with higher current densities in the armature and field windings than are employed in air cooled generators, most hydrogen cooled generators also operate with lower winding temperatures than are usually obtained with air cooled machines; that is, complete advantage of the increased specific output possible with hydrogen cooling is not realized. This reduces the duty on the windings from expansion and contraction and permits the generator to carry a greater fraction of its rated load when operated as an air cooled machine. In Table I are given the temperature rises of the armature and field windings of a few representative hydrogen cooled generators as determined by tests. The amount of load which may be carried

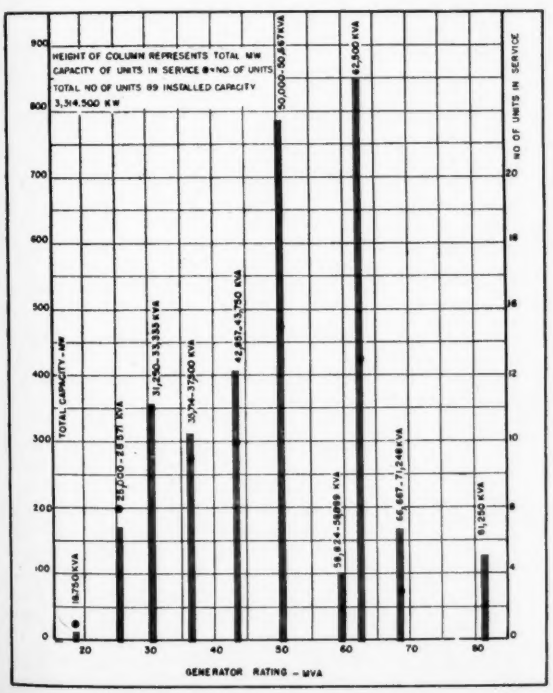

HEIGHT OF COLUMN REPRESENTS TOTAL MW CAPACITY OF UNITS IN SERVICE ●×NO OF UNITS
TOTAL NO OF UNITS 89 INSTALLED CAPACITY 3,314,500 KW
TOTAL CAPACITY - MW
NO OF UNITS IN SERVICE
GENERATOR RATING - MVA

Fig. 1. Size and number of G.E. Hydrogen cooled machines in service—3600 rpm

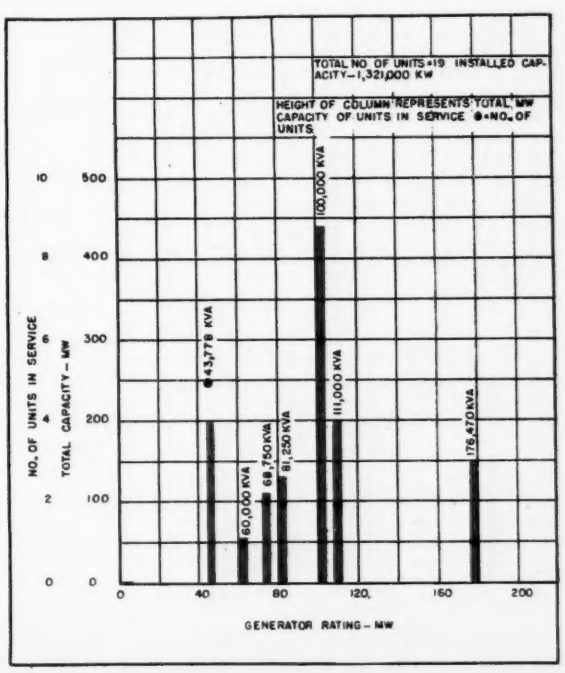
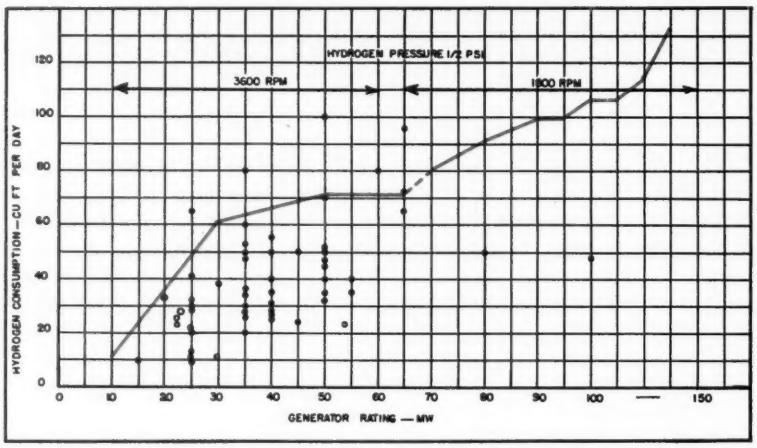

TOTAL NO OF UNITS ×19 INSTALLED CAPACITY-1,321,000 KW
HEIGHT OF COLUMN REPRESENTS TOTAL MW CAPACITY OF UNITS IN SERVICE ●×NO. OF UNITS
NO. OF UNITS IN SERVICE
TOTAL CAPACITY - MW
GENERATOR RATING - MW

Fig. 2. Size and number of G.E. hydrogen cooled machines in service—1800 rpm



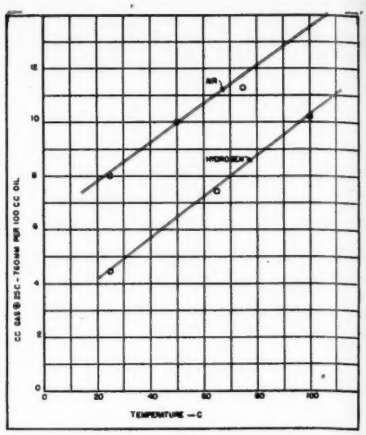


Fig. 3—left. Average daily hydrogen consumption for 76 different generators. (Colored line shows calculated loss of hydrogen by absorption in shaft sealing oil with oil to seals at 110 F). Fig. 4—Right. Solubilty of Air and Hydrogen in turbine lubricating oil at different temperatures in cc of gas at 25 C, 760 mm per 100 cc oil. Oil viscosity = 150 SSU at 100 F, 43 at 210 F. API gravity = 30

by a hydrogen cooled generator when operated in air is usually specified as 60 per cent of the hydrogen rating.

Reduced Maintenance

Inspection of hydrogen cooled generators after many years of service invariably indicates a high degree of cleanliness of the windings and ventilation passages and no evidence of corona damage. Although some heat damage caused by internal faults has occurred in hydrogen cooled generators there has been no fire and the damage has been localized and hence less serious than in similar mishaps in air cooled generators.

Hydrogen Consumption

In Fig. 3 is shown the average daily hydrogen consumption, as determined from operating records, of 76 different hydrogen cooled generators, operating at ½ lb hydrogen pressure. The amounts used range from 10 cubic feet per day for a 15,000 kw unit to 130 cubic feet per day for a 150,000 kw unit, the average loss amounting to about 30 cubic feet per day for generators below 40,000 kw and about 60 cubic feet per day for generators in the larger sizes. At a cost of 2 cents per cubic foot for hydrogen the average yearly cost of hydrogen is thus about $200 for generators below 40,000 kw and about $400 for the larger generators.

The loss of hydrogen from the hydrogen by absorption in the seal oil for gention is made up of the loss by absorption in the oil passing to the hydrogen side of the shaft seals plus the loss by leakage. The loss by absorption in the seal oil is approximately equal to the rate of oil flow to the hydrogen side of the seals times the solubility of hydrogen in the oil. Letting Q represent the hydrogen side seal flow in gpm, S the per unit solubility of hydrogen in oil at atmospheric pressure and P the hydrogen pressure in generator in atmospheres, the loss by absorption La is given by the equation La = 8QPS cu ft per hr. In Fig. 4 the solubilities of hydrogen and air in a typical turbine lubricating oil are shown for different oil temperatures.

In Fig. 3 the calculated loss of hydrogen by absorption in the seal oil for generators of different sizes is shown for comparison with the total measured hydrogen loss. In many cases the actual hydrogen consumption is less than the calculated loss by absorption in the oil, indicating that the calculated values of seal oil flow or the assumed solubility were below the actual values.

TABLE I

Temperature rises of armature and field windings of hydrogen cooled generators at full load in operation at ½ lb hydrogen pressure

Kva	Kv	Rpm	Temp. Rise Armature Winding by Max. Temp. Det. °C	Field Winding by Resistance
25000	12	3600	26	50
35700	12.5	3600	34	48
43750	13.8	3600	36	38
62500	14.4	3600	39	48
62500	13.8	3600	30	59
43778	11	1800	35	65
100000	14.1	1800	47	59
111111	13.8	1800	47	56

Although the majority of the hydrogen cooled generators built by General Electric have been operated regularly only at ½ psi hydrogen pressure, some 22 of them have been operated either regularly or occasionally at hydrogen pressures up to and including 15 psi. The principal advantages obtained through operation at high hydrogen pressures are the following: (1) The kva output of the generator may be increased by at least 1 per cent for each pound increase in hydrogen pressure, for the same operating temperatures of the windings. (2) For constant kva output the temperature of the water supplied to the hydrogen cooler may be increased by at least 1 deg F for each pound increase in hydrogen pressure, for the same operating temperatures of the windings.

The effect on the operating temperatures of a generator obtained by increasing the hydrogen pressure is shown in Table II, in which the temperature rises at full load of the armature and field windings of a hydrogen cooled generator of modern design are shown for different hydrogen pressures. Reductions in temperature of 11 C for the armature winding and of 17 C for the field winding were obtained for this generator by increasing the hydrogen pressure from ½ lb to 15 lb.

Operation at high hydrogen pressures introduces no particular operating difficulties, it being necessary only to change the settings of a few valves in the shaft sealing and hydrogen control systems when the hydrogen pressure is increased above ½ lb. The loss of hydrogen from the generator at high pressures is usually appreciably greater than in ½ lb operation, the loss by absorption in the seal oil increasing directly with the absolute hydrogen pressure while the loss by leakage increases about directly with the gage hydrogen pressure. In general the hydrogen consumption in operation at 15 lb hydrogen pressure is from 3 to 4 times the loss at ½ lb pressure.

Although the problem of moisture in hydrogen cooled generators is normally

non-existent, since the hydrogen supplied to the casing is dry and the oil supplied to the shaft seals is vacuum treated to remove both air and moisture, excessive moisture in the turbine oil or a leak in one of the hydrogen coolers sometimes causes moisture to enter the generator. In many installations measurements of the moisture content of the hydrogen in the generator are taken regularly as a means of detecting an incipient cooler leak. A device for measurement of the absolute humidity of the hydrogen in generators has recently been developed. In Fig. 5 are shown the results of a survey of the moisture conditions in nine representative generators, using a dewpoint potentiometer. None of the generators tested was provided with a dryer. With the moisture content of the supply hydrogen at 0.17 lb per 1000 cubic feet, moisture contents of the hydrogen in the generator of between 0.22 and 1.31 lb per 1000 cubic feet were measured, the highest moisture content being for a generator having a relatively high percentage of moisture in the turbine oil. In no case, however, was a relatively humidity within the generator of more than 30 per cent measured, whereas a value of 50 per cent or even higher would not be detrimental to satisfactory operation.

To insure against unusual moisture conditions, it is the present practice of General Electric to provide a dryer with hydrogen-cooled generators through which hydrogen from the casing is continually passed by the action of the rotor fans. The dryer may be regenerated in position, when required, by vacuum and temperature, the dryer being connected to the vacuum tank of the seal oil treating system and current then applied to a heating coil within the dryer. Experience indicates that the drver usually collects moisture only during the first weeks of operation, after which it may be cut out of service. The moisture conditions in a 30,000 kw generator provided with a drver, for the period following installation, are shown in Fig. 6.

TABLE II

Temperature rises of armature and field windings at full load for 62,500 kva, 0.8 pf, 3600 rpm hydrogen cooled generator as determined by tests at different hydrogen pressures

Hydrogen Pressure Psig	½	5	10	15
Temp. Rise Arm. Wdg. by Max RTD °C	30	24.5	21.2	19
Temp. Rise Field Winding by Resistance °C	59	51	45.5	42

When filling the generator casing with hydrogen, or in removing hydrogen from the casing before opening the latter to atmosphere, an inert gas such as carbon dioxide or nitrogen is normally used to displace the air or hydrogen. This operation, designated as "purging," is usually performed with the generator at rest, although circumstances sometimes require that the casing be filled or emptied with the generator in operation. To determine the amount of inert gas required to perform either operation, the following equation is useful:

$$Q = 2.3\ PVK \log \frac{S - Z_1}{S - Z_2}$$

where

- Q = amount of gas required, cubic feet at atmospheric pressure
- P = pressure in casing, atmospheres
- V = gas space in casing, cubic feet
- K = diffusion constant; = 1 for generator in operation; = 0.5 to 0.7 for generator at standstill, using CO_2; = 0.9 for generator at standstill, using nitrogen
- S = per cent purity of gas being admitted to casing
- Z_1 = per cent of gas of purity S, initially within casing (usually = 0)
- Z_2 = per cent of gas of purity S required in casing.

In removing air from the casing before admitting hydrogen, a mixture of about 70 per cent CO_2 or 80 per cent N_2 in air is required to insure noninflammability of the resulting mixture when hydrogen is introduced. Also in removing hydrogen from the casing a mixture of about 90 per cent CO_2 or 95 per cent N_2 in hydrogen is required to insure non-inflammability of the resulting mixture when the casing is opened to atmosphere. Maintenance of a relatively high pressure in the casing during the purging operation (about 5 psi) has been found to expedite the process. Although nitrogen has been used as the purging agent in some cases, this gas is usually less readily obtainable than CO_2, a greater amount is required, and convenient means for measuring the percentage nitrogen in a mixture with air or hydrogen are not as readily available. The time required for purging a generator using carbon dioxide depends on how rapidly the CO_2 can be admitted without freezing. Hydrogen and nitrogen can be admitted at the rate of about one 200 cu ft cylinder in 10 minutes. For a hydrogen-cooled generator of average size, using CO_2 as the urging agent, about three hours are usually required for filling the casing with hydrogen to 90 per cent

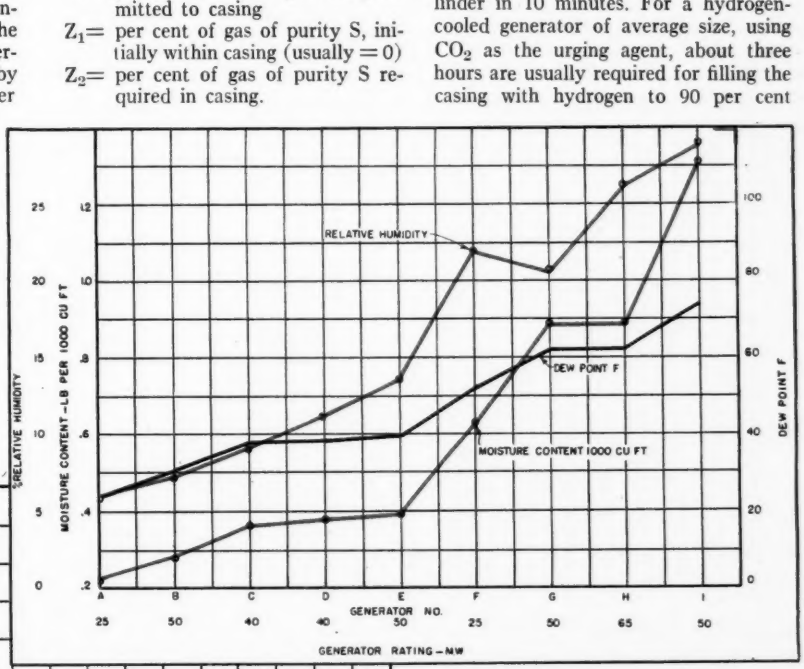

RELATIVE HUMIDITY
DEW POINT F
MOISTURE CONTENT 1000 CU FT
% RELATIVE HUMIDITY
MOISTURE CONTENT - LB PER 1000 CU FT
DEW POINT F
GENERATOR NO.
A B C D E F G H I
25 50 40 40 50 25 50 65 50
GENERATOR RATING - MW

Fig. 5—Above. Moisture content of Hydrogen in 9 different generators as determined by measurement with a dew point potentiometer. None of the generators were provided with driers. Moisture content of supply hydrogen, 0.17 per 1000 cubic feet

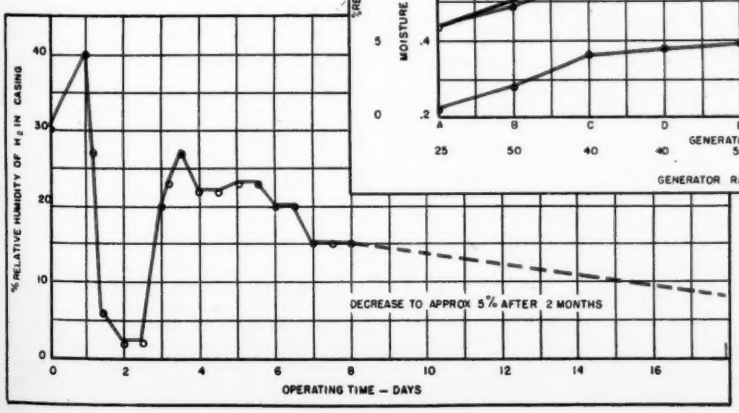


Fig. 6—Left. Relative Humidity in a Hydrogen cooled generator durng initial period of operation. This machine was a 30,000 kw, 0.8 pf, 3600 rpm unit. Dryer provided in gas system

purity and about two hours for removing hydrogen from the casing.

Letting P = 1.34, S = 100, $Z_1 = 0$ in the above equation, the amounts of inert gas and hydrogen required for filling and emptying the casing of a generator, expressed in number of casing volumes, are as follows:

In Fig. 7 the time variation of the concentration of hydrogen in the casing and the amounts of gas admitted are shown for a 30,000 kw generator being filled with hydrogen at speed at 5 lb pressure, and for a 25,000 kw generator being emptied of hydrogen at standstill at ½ lb pressure, CO_2 being used as the purging agent in both cases. For the 30,000 kw generator, filled at speed, 3.13 casing volumes of hydrogen were required to obtain 90 per cent H_2 in CO_2 which checks the amount given in the above table; for the 25,000 kw unit emptied at rest, 1.48 volumes were required to obtain 90 per cent H_2 in CO_2, which is equivalent to 1.93 volumes for P = 1.34, again checking closely with the theoretical amount.

It is sometimes convenient, in the process of filling or emptying the casing, to permit CO_2 to remain in the casing for an extended period. When this is done it is advisable to shut down the vacuum treating system and allow the shaft seals to be supplied with oil from the bearing header, also to admit CO_2 as required to maintain a positive pressure in the casing. Unless these precautions are taken, the vacuum pump may become overloaded, and a negative pressure may be obtained in the generator casing due to the high loss of CO_2 in the sealing oil, the solubility of CO_2 in oil being over ten times that of air.

(To be Continued)

Table III

Operation	Using CO_2			Using N_2		
	% Final Purity Z_2	At Speed (K = 1)	At Rest (K = 0.6)	% Final Purity Z_2	At Speed (K = 1)	At Rest (K = 0.9)
		No. of Casing Volumes			No. of Casing Volumes	
Removing Air	70	1.6	1.0	80	2.1	1.9
Introducing Hydrogen	90	3.1	1.85	90	3.1	2.8
Removing Hydrogen .	90	3.1	1.85	95	4.0	3.6

APPENDIX

Rules for the Safe Handling of Compressed Gases Used with Hydrogen Cooled Generators

Since the handling of compressed gases—especially inflammable gases such as hydrogen—involves elements of danger, the compressed gas industry has formulated a number of rules relative to the safe handling of gases in the compressed form. A number of these rules, together with some data relative to the characteristics of hydrogen and carbon dioxide gas and the construction of the containers for these gases are here given for the benefit of those interested in the operation of hydrogen cooled electrical machinery.

Hydrogen

Hydrogen is a colorless, tasteless, odorless gas having a density 1/14 the density of air, or 0.0052 lb per cu ft at 70 F and atmospheric pressure. It burns with a pale blue, non-luminous flame, but it does not support combustion. In mixture with air or oxygen it is highly explosive, especially if the volume of oxygen is half that of hydrogen. In combination with air it is explosive for mixtures containing between 5 per cent and 7 per cent hydrogen by volume.

Hydrogen is handled commercially in cylinders constructed to I.C.C. specifications 3A-1800, at a pressure of between 1800 and 2000 psig at 70 F. It is supplied at a purity of 99.5 per cent with a tolerance of ± 0.1 per cent. The cylinders are hydraulically tested to 3000 psig. The cylinder valve contains a safety device of the combination frangible disc-fusible plug type, the disc with bursting pressure between 2700 and 3000 psig, and the plug with yield temperature between 208 and 220 F. The pressure in a cylinder charged to 2000 psig at 70 F will increase about 3.66 psi per deg F increase in temperature. Thus at 100 F the cylinder pressure would be approximately 2110 psig, and at 125 F approximately 2200 psig.

Carbon Dioxide

Carbon dioxide gas is colorless, possessing a faint pungent smell and a slightly acid taste. It does not burn and does not ordinarily support combustion. It is 1.53 times heavier than air, having a density of 0.115 lb per cu ft at 70 F and atmospheric pressure. It requires a pressure of 520 psig to liquefy it at 32 F. Its critical temperature and pressure (above which the liquid changes to a gas) are 88 F and 1050 psig.

Carbon dioxide is handled commercially in cylinders manufactured to I.C.C. specifications 3A-1800, which are charged to a pressure of 840 psig at 70 F. The gas is usually supplied at a purity of approximately 99.5 per cent. The cylinders are hydraulically tested to 3000 psig at time of manufacture, and then tested again every 5 years thereafter. Most carbon dioxide cylinders are equipped with safety fusible plugs and frangible discs in accordance with Bureau of Explosives regulations. The fusible plugs have a yield temperature of 208 to 220 F and the discs have a bursting range of between 1800 and 2800 psig. At 100 F the pressure in a full cylinder will rise to about 1300 psig, and at 125 F to about 2300 psig.

At 70 F a full 50 lb cylinder contains 45 lb of liquid and 5 lb of gas, the liquid occupying about 70.2 per cent of the volumetric capacity of the cylinder.

Safety Rules

The following rules have been reprinted from a pamphlet published by the Compressed Gas Manufacturer's Association and are based upon accident prevention experience within the compressed gas industry.

General

1. Never drop cylinders nor permit them to strike each other violently. (Cylinders should be chained to prevent them from falling over.)
2. Never use a lifting magnet nor a sling (rope or chain) when handling cylinders. Provide a safe cradle or platform to hold the cylinders whenever a crane is used.
3. When returning empty cylinders remove lower portion of the shipping tag attached to the cylinder. Bill of lading should specify number of cylinders, consignee and the fact that cylinders are empty. A copy of bill of lading should be sent to the consignee. Close valve before shipment. See that cylinder valve protective caps and outlet caps, if used, are replaced before shipping.
4. Where caps are provided for valve protection, such caps should be kept on cylinders except when cylinders are in use.
5. Never use cylinders for rollers, supports, or for any purpose other than to carry gas.
6. Never tamper with the safety devices in valves or cylinders.
7. Open cylinder valves slowly. Never use wrenches or tools except those provided or approved by the gas manufacturer. Never hammer the valve wheel in attempting to open or close the valve.
8. Make sure that the threads on regulators, or other auxiliary equipment are the same as those on cylinder valve outlets. Never force connections that do not fit.
9. Never attempt to repair or alter cylinders or valves.
10. Protect cylinders against excessive rise of temperature. Cylinders may be stored in the open but in such case should be protected against extremes of weather and from the ground beneath to prevent rusting. During winter, cylinders stored in the open should be protected against accumulations of ice or snow. In summer, cylinders stored in the open should be screened against continuous direct rays of sun.
11. No part of any cylinder containing a compressed gas should ever be subjected to a temperature above 125 F. A direct flame should never be permitted to come in contact with any part of a compressed gas cylinder.
12. Never store cylinders near highly inflammable substances such as oil, gasoline, waste, etc.
13. Cylinders should not be exposed to continual dampness.
14. Store full and empty cylinders apart to avoid confusion.
15. Do not store cylinders near elevators or gangways, or in locations where heavy moving objects may strike or fall on them.
16. When in doubt about the handling of a compressed gas cylinder or its content, consult the manufacturer of the gas.
17. Be careful to protect cylinders from any object that will produce a cut or other abrasion in the surface of the metal.

Hydrogen

1. Keep sparks and flame away from cylinder.
2. Connections to piping, regulators, and other appliances should always be kept tight to prevent leakage.
3. Never use an open flame to detect hydrogen leaks. Use soapy water. During freezing weather linseed oil may be used.
4. When cylinders are not in use, keep valves tightly closed.
5. After removing valve cap, slightly open valve an instant to clear opening of particles of dust or dirt.
6. If valve is difficult to open, point the valve opening away from you, and use greater force. Avoid, however, the use of a wrench on valves equipped with handwheels.
7. After attaching regulator and before opening cylinder valve, see that adjusting screw of regulator is released.
8. Never permit the gas to enter the regulator suddenly. Open the cylinder valve slowly. (When the high pressure gage registers full cylinder pressure the valve handle shall then be screwed to its "full open" position.)
9. Before regulator is removed from a cylinder, close the cylinder valve and release all gas from regulator.
10. Do not exhaust cylinders completely. Leave at least 5 psi pressure in each. Make sure the cylinder valves are closed tightly. Mark empty cylinders "M."
11. Store all cylinders containing hydrogen in a well ventilated place.
12. If a cylinder is found to be leaking it should be immediately moved out of doors. If the leak cannot be stopped, a warning should be placed near the cylinder not to approach it with lighted cigarettes or other means of ignition.

Carbon Dioxide

1. If it is necessary to immerse a cylinder in a bath of warm water to facilitate discharge, care must be taken to assure sufficient discharge at all times, to prevent a dangerous pressure in the cylinder. The temperature of the water bath should never exceed 125 F. In no event should the cylinder valve be submerged nor more than 20 per cent of the surface area of the cylinder be under the water.
2. Great care should be taken to avoid the backing up of water into the cylinder—particularly during the winter on account of the danger of freezing—or the entry of any foreign matter, such as oil, into or around the valve.

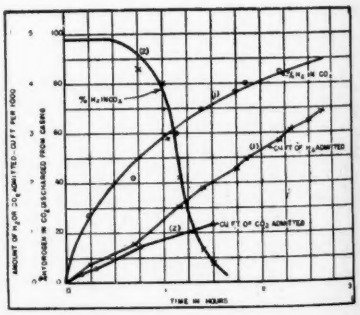


Fig. 7. Change in per cent hydrogen discharged from generator casing during filling and purging operations. Operations performed at standstill and at speed. From tests on two different generators: (1) 30,000 kw, 3600 rpm filled with hydrogen at speed; (2) 25,000 kw, 3600 rpm generator, hydrogen removed with CO_2 at standstill

Air Distribution Makes or Breaks Air Conditioning

By **LEONARD R. PHILLIPS** Consulting Engineer, Anemostat Corporation of America

EVERYONE KNOWS where the responsibility of the power plant engineer begins. But in various phases of power plant operation it is often difficult to determine just where his responsibility should end. When generating electricity, for example, his duties may or may not carry over into transmission and distribution.

On the other hand, a power plant engineer should be responsible for the entire air conditioning system in a plant. This means more than merely supplying the required volume of properly conditioned air, for if the air circulates improperly—even after it leaves the ducts—the power plant engineer will receive complaints.

Such complaints may seem unwarranted when thermostats and other standard instruments of the system indicate that everything is operating properly. However, if complaints are numerous (and do not come from cranks!) or if an industrial process is affected, the engineer should make a check.

Often an ordinary thermometer and a psychrometer for humidity measurements will convince him that the complaints are justified. By taking readings at various points about the room, from the floor to the ceiling, he will often find wide temperature differentials.

If both temperature and humidity are unequalized to any extent, undoubtedly there will be a wide variance in air velocities throughout the conditioned enclosure. An engineer can convince himself of this simply by noting how the air movement affects a match flame, tobacco smoke, or cotton fluff.

An accurate test may then be made with a thermo-anemometer (thermometer anemometer).

A Kata-thermometer may be used for the same purpose. However, it is cumbersome and requires more time to operate.

How Improper Air Distribution Occurs

If the previously mentioned tests indicate that air is being improperly distributed throughout the enclosure, often the fault can be found at the air-duct openings. In a shipping room of one mid-western plant, for example, blasts of cold air from two unit coolers were so severe that employees could not endure room temperature of 50 F, even though lower temperatures were essential to proper plant operation. When conventional horizontal grilles on the unit coolers were replaced by scientifically designed air-diffusers, the unsatisfactory conditions were immediately eliminated.

In another plant, the air-conditioning system failed to maintain the temperature and humidity required for the manfacturing process. A study showed that air was being improperly distributed after leaving the ducts. When efficient air-diffusers were used to replace grilles at the duct openings, the required temperature and humidity were closely maintained throughout the room even though air changes were substantially increased.

When cold air enters a room through conventional duct outlets—grilles, registers or perforated panels—it usually sweeps to the floor and forces the warmer room air to the ceiling. Until the velocity of the cold incoming air subsides, it cannot mix with the warmer room air. This results in a room filled with drafts and turbulent air; temperature differentials are great throughout the room; humidity is unequalized, and stagnant air pockets are prevalent.

How Proper Air Diffuser Distributes the Air

In the plants previously mentioned, such unsatisfactory conditions were rec-

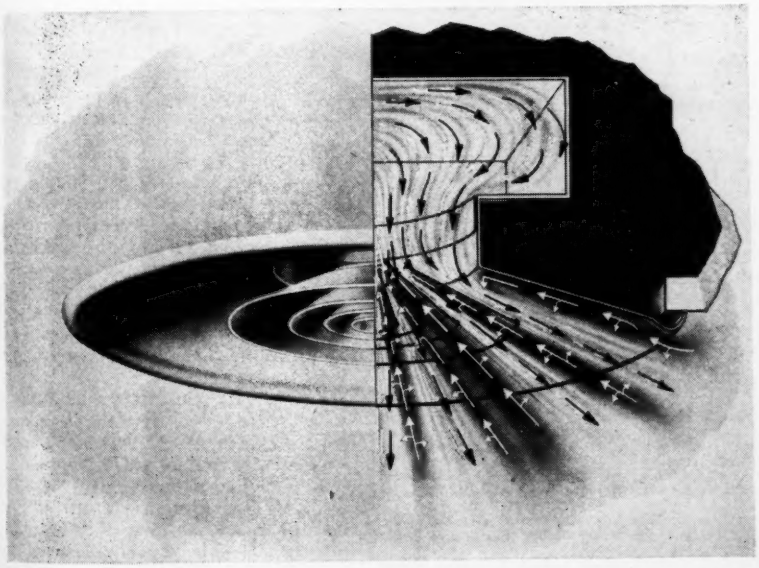


Fig. 1. How Anemostat air-diffuser works. Metal cones designed so that air from ducts (blue arrows) siphons series of counter-currents of room air (white arrows) back into cones. Simultaneously, air-expansion within cones greatly reduces incoming air-velocity. In this way, supply is pre-mixed with about a third of its volume of room air within diffuser before mixture is slowly and thoroughly spread throughout room in draftless pattern

Fig. 2. Anemostat installed in control room of Station WFBR, Baltimore, helps maintain proper noise-levels, protect delicate electrical equipment, and afford maximum comfort to operator. Conditions similar to central station and industrial power plant control rooms

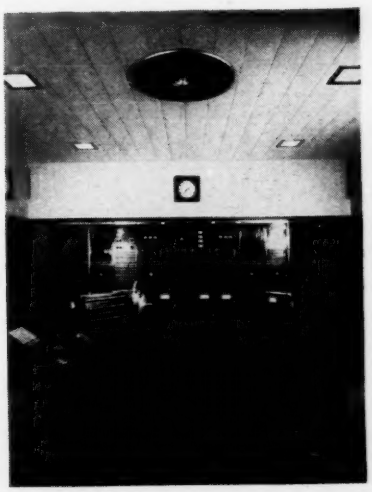


Table I. Various factors to be considered in selecting proper Anemostat air-diffusers for stationary installations

KEY X = YES, RECOMMENDED HO = CONSULT HOME OFFICE O = NO, NOT RECOMMENDED A = DEPENDS UPON UNIT HEATER AND FAN. B = NO. DEFINITE LIMIT.
C = ONLY SIZES 30, 35, 40 D = DIRECT CONTROL DAMPER HORIZ. OR VERTICAL E = ONLY IF USED ON EXPOSED DUCT WORK. F = FLUSH TO WALL.

		TYPES											
		AC	AR	B	C	CM	CCM	CSL	NL	HU-3	HU-4	W	REMARKS
DESIGN	No. of (Members, Cones)	6	6	5	5	4	3	5	3 (40-4)	3	4	7 (#5-5)	
	Flush Design	X	O	O	X	X	O	X	O	O	O	X	
	Projecting Design	O	X	X	O	O	X	O	X	X	X	O	
SIZES AVAILABLE	Size	10 to 60	15 to 130	10 to 95	10 to 95	5 to 30	7 5 to 75	20 to 95	15 to 40	25 to 75,75S	25 to 75,75S	5 to 40	
FUNCTION	Supply Only	O	X	X	X	X	X	X	X	X	X	X	
	Supply and Exhaust	X	O	O	O	O	O	O	O	O	O	O	
ASPIRATION %		30%	30%	35%	35%	30%	25%	35%	30%	A	A	35%	
APPLICATION	Comfort	X	X	X	X	X	X	X	X	HO	HO	X	
	Commercial	X	X	X	X	X	X	X	X	HO	HO	X	
	Industrial	HO	X	X	HO	X	X	O	O	X	X	X	
ANTI-SMUDGING		O	O	O	X	O	X	O	O	O	O	X	
PERFORMANCE	Heating	HO	X	X	X	X	X	X	HO	X	X	X	
	Cooling	X	X	X	X	X	X	X	X	O	O	X	
	Ventilating	X	X	X	X	X	X	X	X	HO	HO	X	
	Refrigeration	HO	X	X	HO	HO	O	O	O	O	O	HO	
MAX. MOUNTING HT.		14'	No Definite Limit, Consult HO for Extreme Heights						20	40'	20'	B	
EQUALIZING FEATURE	E. D	O	X	X	X	X	X	X	C	HO	HO	D	
	A. E. D	X	O	O	O	O	O	O	O	O	O	O	
	R. D	O	O	O	O	O	O	O	O	X	X	O	
VOLUME CONTROL	S. D	O	X	X	X	X	X	X	X	E	E	Special	
MAY BE COMBINED WITH	Drop Light Fixture	X	X	X	X	X	X	HO	O	E	E	O	
	Direct Center Light	O	O	O	"CRL"	"CRL"	O	O	X	O	O	O	
	Indirect Cove Light	O	HO	HO	"CS."	O	O	X	O	O	O	O	
	Projection Unit Heaters	O	O	O	O	O	O	O	O	X	X	O	
INSTALLATION	Flush to Ceiling	X	X	X	X	X	X	O	X	HO	HO	F	
	Exposed Ductwork	X	X	X	O	X	X	X	O	X	X	X	
		"AC" Only Supply Exhaust Type Anemostat Air Diffuser	"AR" Especially Useful for High Rates of Air Change and Temperature Differentials	"B" General Application under Practically All Conditions	"C" For Flush to Ceiling Jobs Only-Anti-Smudging	"CM" O.K. for Stationary Jobs Tho' Designed for Transport Usage	"CCM" Low Price Unit for General Usage	"CSL" Cove Light Combination Only Where Special Lighting Effect Desired	"NL" Special Lighting Combination	"HU-3" Mostly Recommended in Combination with Vertical Projection Unit Heaters	"HU-4"	"W" Only Sidewall Anemostat Air Diffuser	

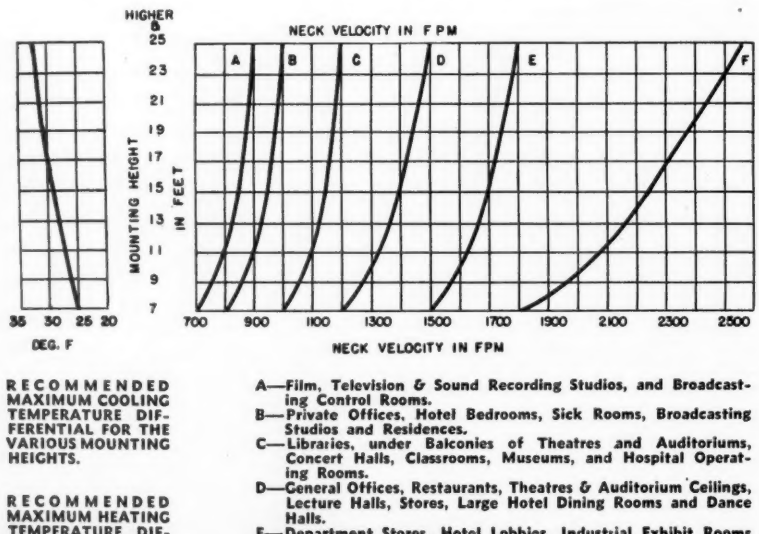
tified by installing a patented device known as the Anemostat air-diffuser. This device, as shown, is composed of a series of scientfically designed metal cones assembled in definite relation to each other. Air entering a room passes through these cones and, because of their unique design, is instantly reduced in velocity within the device. Simultaneously, air from the room—equal to about 35 per cent of the incoming air—is siphoned into the diffuser where it is mixed with the incoming air.

The pre-mixed air then leaves the Anemostat at a low velocity and spreads over a pre-determined area above the occupancy zone before slowly entering that portion of the room.

Because the primary air mixing action takes place within this air-diffuser, and because all major air turbulence is limited to its vicinity, no drafts are perceptible to occupants.

It might be said that the air-mixture then "settles" into the room instead of "sweeping" in, as it does when conventional fixtures are used at duct openings. Therefore, obstacles such as columns, machines and furnishings do not deflect the air-flow. And stagnant air pockets—whether under-cooled or over-cooled—are eliminated.

The over-all result is even, draftless air-distribution that causes both temperature and humidity to be closely equalized throughout the room.



RECOMMENDED MAXIMUM COOLING TEMPERATURE DIFFERENTIAL FOR THE VARIOUS MOUNTING HEIGHTS.

RECOMMENDED MAXIMUM HEATING TEMPERATURE DIFFERENTIAL IS SIXTY DEGREES F FOR ANY CEILING HEIGHTS.

A—Film, Television & Sound Recording Studios, and Broadcasting Control Rooms.
B—Private Offices, Hotel Bedrooms, Sick Rooms, Broadcasting Studios and Residences.
C—Libraries, under Balconies of Theatres and Auditoriums, Concert Halls, Classrooms, Museums, and Hospital Operating Rooms.
D—General Offices, Restaurants, Theatres & Auditorium Ceilings, Lecture Halls, Stores, Large Hotel Dining Rooms and Dance Halls.
E—Department Stores, Hotel Lobbies, Industrial Exhibit Rooms and Restaurant Kitchens.
F—Factories, Store Rooms, Engine Rooms, Greenhouses, and spaces where Duct Noise is of no Importance.

Fig. 3. Recommended velocities for neck of diffuser will depend on conditions and type selected. These curves are for a Type B Anemostat

However, before air can be distributed in this controlled pattern, various factors must be considered including the area of the room, height of ceiling, design of ceiling, locations of duct openings, duct sizes, duct velocities, permissible air velocities within the room, number of air-changes per hour, permissible sound levels, location of columns and other obstructions, the location, type and heat-load of lighting fixtures, location of exhaust outlets, unusual concentrations of internal heat, solar radiation, and other items.

Because of these various factors, one single design of Anemostat could not be expected to solve all air-distribution problems. Therefore, different designs are used for different conditions. For example, 180 Anemostats are used in a large building of the International Business Machines Corp. at Endicott, N.Y. Because conditions differ throughout this building, 72 of the devices are wall-type diffusers and 108 are ceiling-type. In some parts of the building duct velocities exceed 1500 fpm, yet velocities in occupancy levels of rooms do not exceed 40 fpm—less than one half mile per hour.

Since these air-diffusers circulate air of the highest duct velocities in a draftless pattern, they make it possible to install smaller ducts to handle larger volumes of air. Duct layouts also may be simplified because these efficient air-diffusers—when properly selected and located—thoroughly distribute the air in spite of machines, columns, and other obstacles. Small ducts and simplified layouts enable a plant engineer to save valuable space and reduce installation costs.

The versatility of these air-diffusers is demonstrated by the fact that nearly 1,000,000 Anemostats are now successfully operating in heating, ventilating, air conditioning, and refrigeration systems of all kinds.

Air-distribution does not end at a duct opening. Here, in fact, is where scientific air distribution begins—the air distribution that makes or breaks air conditioning.

Fig. 4. Smoke diffusing as it leaves Anemostat on test in huge machine shop of U. S. Army ordnance plant in Gadsden, Ala. Air distributed throughout this plant at 792,000 cfm by 48 of these large diffusers

Size No.	Neck Dia. In.	Neck Area Sq. In.	Neck Area Sq. Ft.	NECK VELOCITY IN FEET PER MINUTE															
				700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2200	2500	3000
				CAPACITY IN CUBIC FEET PER MINUTE															
10	4	12.56	.087	61.1	69.8	78.5	87.3	96.0	105	113	122	*131	140	148	157	166	175	192	218	262
12.5	5	19.63	.136	95.4	109	123	136	150	164	177	191	205	218	232	245	259	273	300	341	409
15	6	28.27	.196	137	157	177	196	216	236	255	275	295	314	334	353	373	393	432	491	589
20	8	50.26	.349	244	279	314	349	384	419	454	489	524	558	593	628	663	698	768	873	1047
25	10	78.54	.545	382	436	491	545	600	655	709	764	818	873	927	982	1036	1091	1200	1364	1636
30	12	113.10	.785	550	628	707	785	864	942	1021	1100	1178	1257	1335	1414	1492	1571	1728	1964	2356
35	14	153.94	1.069	748	855	962	1069	1176	1283	1390	1497	1604	1710	1817	1924	2031	2138	2352	2673	3207
40	16	201.06	1.396	977	1117	1257	1396	1536	1676	1815	1955	2094	2234	2374	2513	2653	2793	3072	3491	4189
45	18	254.47	1.767	1237	1414	1590	1767	1944	2121	2297	2474	2651	2828	3004	3181	3358	3534	3888	4418	5302
50	20	314.16	2.181	1527	1745	1963	2182	2400	2618	2836	3054	3272	3491	3709	3927	4145	4363	4800	5454	6545
55	22	380.13	2.639	1848	2112	2376	2640	2904	3168	3432	3696	3960	4224	4488	4752	5016	5280	5808	6600	7919
60	24	452.39	3.141	2199	2513	2827	3142	3456	3770	4084	4398	4712	5027	5341	5655	5969	6283	6912	7854	9425
65	26	530.93	3.687	2581	2950	3318	3687	4056	4424	4793	5162	5531	5899	6268	6637	7005	7374	8111	9218	11061
75	30	706.86	4.908	3436	3927	4418	4909	5400	5891	6381	6872	7363	7854	8345	8836	9327	9818	10799	12272	14726
95	38	1134.10	7.875	5513	6301	7088	7876	8663	9451	10238	11026	11814	12601	13389	14176	14964	15751	17327	19689	23627

Table II. Air-diffuser size should depend upon recommended neck velocities and volume of air it is to handle. On this chart for the Type B Anemostat, size numbers roughly correspond to diameter in inches of the largest cone. Sizes 75 to 95, each 68 in. in diameter, are exceptions

Table III—Below. Table showing radius of diffusion in feet for Type B Anemostats using various neck velocities

Size No.	Neck Dia.	NECK VELOCITIES IN FEET PER MINUTE																
		700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2200	2500	3000
10	4"	3-5	3-5	3-6	3-6	3-6	3-7	3-7	3-7	3-7	3-8	4-8	4-8	4-8	4-9	4-9	5-10	5-11
12.5	5"	3-6	3-7	3-7	3-7	4-8	4-8	4-9	4-9	4-9	4-10	5-10	5-10	5-11	5-11	5-11	6-12	7-14
15	6"	4-8	4-8	4-9	4-9	4-9	4-10	5-10	5-11	5-11	5-11	6-12	6-12	6-12	6-13	7-13	7-15	8-17
20	8"	5-10	5-11	5-11	6-12	6-12	6-13	6-13	7-14	7-15	7-15	8-16	8-16	8-17	8-17	9-18	10-20	11-23
25	10"	6-13	6-13	7-14	7-15	7-16	8-16	8-17	8-17	9-18	9-19	9-20	10-20	10-21	10-22	11-23	12-25	14-28
30	12"	8-15	8-16	8-17	9-18	9-19	9-19	10-20	10-21	11-22	11-23	11-23	12-24	12-25	13-26	13-27	15-30	17-34
35	14"	9-18	9-19	9-20	10-21	10-22	11-23	12-24	12-24	12-25	13-26	13-27	14-28	14-29	15-30	16-32	17-35	20-39
40	16"	10-21	10-22	11-23	11-24	12-25	13-26	13-27	14-28	14-29	15-30	15-31	16-32	16-33	17-34	18-36	20-40	22-45
45	18"	11-23	12-24	12-25	13-27	13-28	14-29	15-30	15-31	16-33	17-34	17-35	18-36	18-37	19-39	20-41	22-45	25-50
50	20"	12-26	13-27	14-28	14-30	15-31	16-32	16-33	17-35	18-36	18-37	19-39	20-40	20-42	21-43	22-46	25-50	28-56
55	22"	14-28	14-30	15-31	16-33	17-34	17-35	18-37	19-39	20-40	20-41	21-43	22-44	23-46	23-47	25-50	27-54	31-62
60	24"	15-31	16-32	17-34	17-35	18-37	19-39	20-40	21-42	21-43	22-45	23-47	24-48	25-50	25-51	27-54	30-60	33-67
65	26"	16-33	17-35	18-37	19-38	20-40	21-42	21-44	22-45	23-47	24-49	25-50	26-52	27-54	28-55	29-59	32-64	36-73
75	30"	19-38	20-40	21-42	22-44	23-46	24-48	25-50	26-52	27-54	28-56	29-58	30-60	31-62	32-64	34-68	37-74	42-84
95	38"	24-48	25-51	26-53	27-56	29-58	30-61	31-63	33-66	34-69	35-71	36-74	38-76	39-79	40-81	43-86	47-94	53-106

Economizer Re-design Stops Leaks, Cuts Maintenance, Boosts Efficiency

Economizer tube leakage caused frequent boiler outage . . . Economizers were re-designed for U-bend tubes rolled into headers at one end only . . . Tubes were cut and welded on the job, bends made and welded on, supports designed and fabricated all by regular station crew . . . Tubes and headers now kept dry, no more trouble from flyash racting with moisture . . . Number of joints and headers cut in half

By J. B. COTTER

Superintendent, Grand Tower Power Station, Central Illinois Public Service Co., Grand Tower, Illinois

BOILER OUTAGE at this station, due to economizer tube leakage, became so frequent that definite steps had to be taken to remedy the situation and provide for more continuous boiler service. In doing so, the truth of the maxim "Necessity is the mother of invention" was manifested once more.

The six 7,080-sq ft economizers operate with a pressure of approximately 450 psi with a boiler pressure of 400 psi. As originally installed, the economizers were designed with 16-ft long straight tubes rolled in forged, square box-type headers on each end. The bottom header has the boiler feedwater inlet connection on one end and a blow down connection on the opposite end; the top header has the feedwater outlet connection. These economizers are of the counter flow type; the hot boiler flue gases enter at the top of the economizer and discharge at the bottom into the smoke box breeching leading to the induced draft fan, while the feedwater enters at the bottom of the economizer and discharges at the top.

These economizers have a very easy water flow resulting in a somewhat uneven velocity through the 840 tubes which are banked 20 rows wide and 42 rows high. The tube leakage was caused by the tubes slipping at the roll in the header tube holes because of expansion and contraction caused by hot and cold streaks throughout the economizer. Of course, after the tubes had loosened up in the headers, there was a slight leakage of water around the tubes adjacent to the headers. When this leakage water came in contact with the flyash on the tubes, a disastrous chemical action immediately set up, which quickly attacked the metal. In a very short time, holes would be eaten through the tube wall near the header box. Boiler outage was then necessary for replacing the defective tube. This slight leakage also caused serious erosion to the headers at the tube holes.

Speedy correction of the trouble was necessary. The idea of a new type U-bend tube, with ends rolled in headers at one end only, was decided upon, and all succeeding steps toward re-designing were made in that direction. The final results have been highly successful, as detailed below.

Three of the six 7,080-sq ft economizers have now been completely renovated and designed using the new style U-bend tubes, installed as in Fig. 1. All designing, preparations, fabricating—in fact, all work from start to finish has been performed at the power station by the regular crew of men. The photographs show various stages of the work in progress and in final installation.

As noted on Fig. 1 the tube units are made up of 6 gage, 2-in. OD tubes with the open ends seal-welded and rolled into the headers at one end of the economizer. The U-bend end of the tube unit is carried on tube support A and spaced and held in place with the tube spacer bar B, the U-bend end being elevated ¾ in. to provide for tube drainage when the economizer is drained. When the tube ends are placed in the header tube holes, they are first expanded tight, then seal-welded (through

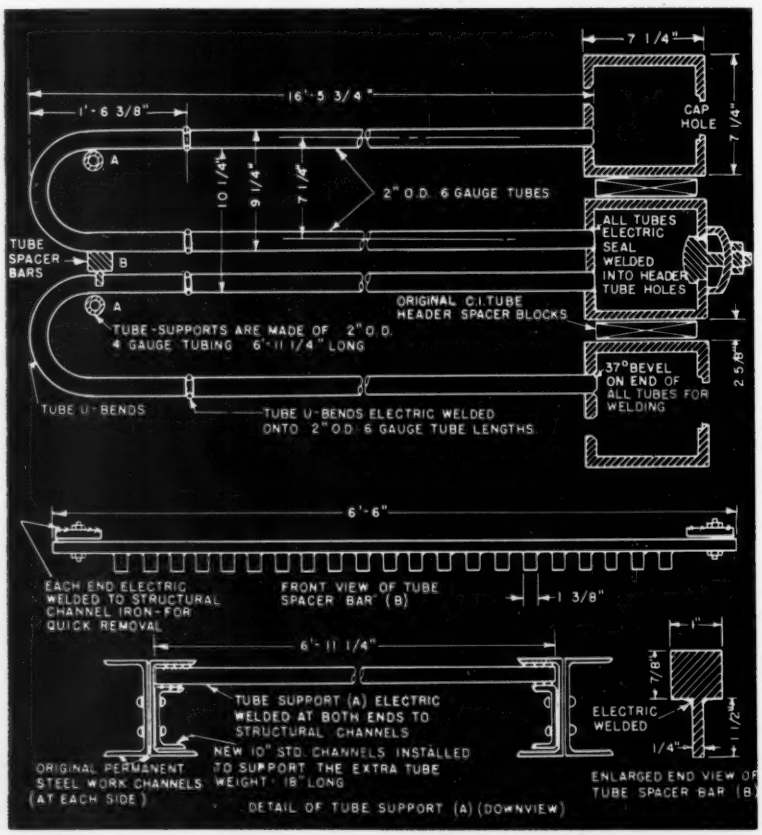
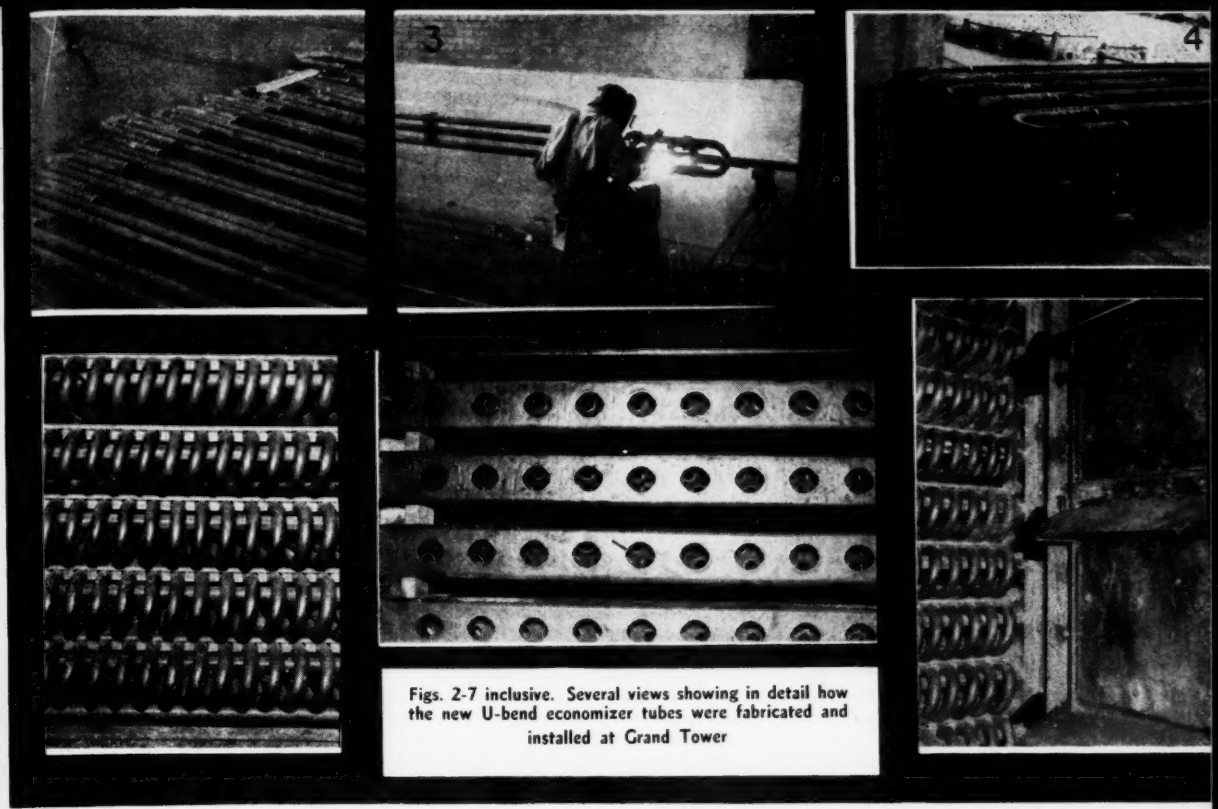

7 1/4"
16'-5 3/4"
1'-6 3/8"
CAP HOLE
7 1/4"
A
10 1/4"
9 1/4"
7 1/4"
2" O.D. 6 GAUGE TUBES
ALL TUBES ELECTRIC SEAL WELDED INTO HEADER TUBE HOLES
TUBE SPACER BARS
B
A
ORIGINAL C.I. TUBE HEADER SPACER BLOCKS
TUBE-SUPPORTS ARE MADE OF 2" O.D. 4 GAUGE TUBING 6'-11 1/4" LONG
37° BEVEL ON END OF ALL TUBES FOR WELDING
2 5/8"
TUBE U-BENDS
TUBE U-BENDS ELECTRIC WELDED ONTO 2" O.D. 6 GAUGE TUBE LENGTHS
6'-6"
EACH END ELECTRIC WELDED TO STRUCTURAL CHANNEL IRON-FOR QUICK REMOVAL
FRONT VIEW OF TUBE SPACER BAR (B)
1 3/8"
6'-11 1/4"
1"
7/8"
TUBE SUPPORT (A) ELECTRIC WELDED AT BOTH ENDS TO STRUCTURAL CHANNELS
ELECTRIC WELDED
1 1/2"
1/4"
NEW 10" STD. CHANNELS INSTALLED TO SUPPORT THE EXTRA TUBE WEIGHT - 18" LONG
ORIGINAL PERMANENT STEEL WORK CHANNELS (AT EACH SIDE)
ENLARGED END VIEW OF TUBE SPACER BAR (B)
DETAIL OF TUBE SUPPORT (A) (DOWNVIEW)

Fig. 1. Working drawing showing details of new style U-bend tubes installed in economizers at Grand Tower Station



Figs. 2-7 inclusive. Several views showing in detail how the new U-bend economizer tubes were fabricated and installed at Grand Tower

Fig. 2. Tubes cut and U-bends formed ready for welding. Fig. 3. One of the two welders joining bends to tubes; using a jig made up on the job, 2520 welds for three economizers made and not a single leak. Fig. 4. A pile of the new tube units after welding, ready for installation. Fig. 5. U-bend tubes installed in economizer, showing spacer bars and tube supports. Fig. 6. How open ends of tubes are expanded into tube headers. Cast iron spacer blocks at left. Fig. 7. Draft deflectors on economizer doors prevent flue gas from by-passing tube ends, when doors are closed. All this work was done successfully by regular station crew.

the header cap holes), and finally re-rolled, to get the tube wall solid against the header tube hole following the heating from the electrical seal-welding.

Processing of the new style U-bend tube units is first started by sawing 6-gage 2-in. OD tubing into pieces of proper length to make the U-bends; the ends are beveled for welding. These short pieces of tubes are then filled and tamped with sand, heated to the desired temperature for bending and then formed in the power station pipe bender. Five men were able to heat, form, and gage to exact dimensions 75 bends in only 5 hours time.

To start making up the new style tube units, a jig was set up (using the flat surface of a 10-in. channel iron 18 ft long) on which was placed the U-bend and the two straight lengths of tubes so they could be matched, marked, and the tube ends cut off at exact, identical lengths before being welded together. Figure 2 shows a quantity of bends and tube lengths ready to be welded into the U-bend tube units.

Figure 3 shows the actual process of welding the tube bends to the tube lengths. The jig in which the bend and tube lengths are placed and held in position for welding was designed and made up here on the job. With the ends of the jig resting on rollers, the operator was able to turn the material and thus prevent breaking of the arc as he made the weld.

Following the welding, the bend end of the newly constructed U-bend tube unit was placed in a trough of water and tested for leaks with 90 psi air pressure. In the 2,520 welds required for making up the new tube units for three economizer retubing jobs, not a single leak was found. To this we say "Hats Off!" to the two expert welders who accomplished this.

Figure 4 pictures a quantity of the new tube units following welding and clearly shows the welds.

Figures 5 and 6 show the new style U-bend tube units installed in place in the economizer. Figure 5 shows the U-bend end and shows the spacer bars B and tube supports A referred to in Fig. 1. The spacer bars B not only provide proper spacing of tubes, but also serve as a steady rest for the next row of tube units immediately above. The slight leaning position of the bends is caused by the two open ends of the tube units being placed in separate headers which have staggered tube holes.

Figure 6 pictures the open end of the tubes expanded in the tube headers. In this new design of economizer, the header tube holes are not grooved. Also, at the left can be seen the header cast-iron spacer blocks, which provide for the proper spacing of approximately 2⅝ in. in this case.

Figure 7 was made expressly to show the draft deflectors installed on the economizer doors. The deflectors are spaced between every third bank of tube bends. When all four doors are closed, the deflectors fit in close to the tube spacer bars and thus serve as baffles to prevent the hot flue gases from by-passing down through the otherwise open space between the doors and the tube bends.

Some of the outstanding and distinct advantages and benefits derived from the redesigned economizers are as follows:

1. Elimination of all leakage.
2. Vast reduction in maintenance costs for labor and material formerly required for replacing leaky tubes.
3. Boiler outage greatly reduced.
4. Increased boiler efficiency resulting from not having to cool down and bring up boilers so frequently for economizer tube replacements.
5. Cleaner economizers due to elimination of the moisture which mixed with the flyash.
6. The U-bend type tubes can be cleaned inside with a turbine cleaner, if and when necessary.
7. Only one half as many headers, caps, and gaskets required.
8. Only one half the original number of tube ends to be expanded in headers.
9. Longer life. From the very start, much thought and study were given to this economizer re-designing work and the main idea was to provide for keeping the tubes and headers thoroughly dry at all times. Now that this goal has been attained, these economizers should last at least 25 years with very little maintenance.

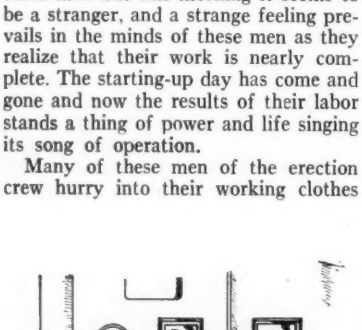
Placing the Steam Generator in Operation-I

By **JOHN C. GORE,** Power Engineer, General Foods Corp., Post Cereal Division

DAWN FILTERS through the high windows of the power plant revealing a huge metal giant attended by several men who gaze with sleep-heavy eyes at curious instruments and gages which tell them of the conditions existing behind those metal walls. A strange feeling of power and force seems to emanate from the vast metal walls which reach high into the darkness of the upper building. The noises which seem somehow to be part of the strange flickering lights visible through the port holes in the front of the unit; the warmth radiated from the walls and the quivering vibration in the air give one the impression of life in the giant. The large boiler is in service and indeed it seems to breathe and to be a living thing to the men in charge of its operation.

Shortly after dawn the erection crews who have built the giant begin to drift into the plant to finish their work and they find the huge steam generator in service. It radiates warmth in the chill morning air for which they are grateful and its many noises seem to sing a song of greeting to the men who have spent so many painstaking hours making certain that all details of the giant were correct. It has been an old friend to these men but this morning it seems to be a stranger, and a strange feeling prevails in the minds of these men as they realize that their work is nearly complete. The starting-up day has come and gone and now the results of their labor stands a thing of power and life singing its song of operation.

Many of these men of the erection crew hurry into their working clothes and make their way to the control panels to satisfy their curiosity as to how the new equipment is working. The hour is early as these men are working long overtime days to complete the insulation, steel casing erection and other minor details which remain to be finished before these restless men can move along to another job. As they gather at the operating and control panels even the early arrivals find that the plant officials are already on the scene.



He sat down to rest his tired body and drink a cup of coffee

Tired men, their faces darkened by unshaven shadows, their clothing wrinkled and showing the natural pajama-like disorder of any clothing which has been slept in, are examining the various instruments. These men are hardly recognizable as plant officials after a night spent in the plant, but their keen eyes are searching every chart for any indication of faulty operation of equipment which may have occurred during the night. The log books are examined and the boiler log with only one page filled is read and reread to determine if any unusual operating conditions were noted during the past night. The erectors also glance at the boiler log noting the smudged, grease and dirt-stained paper which looks like some of the work notes they carry in the pockets of their dirty cover-alls. They note that an oil burner was lighted at 12:58 a m, that a pulverizer was started at 1:03 a m, and that a coal feeder was started at 1:04 a m. This information seems unimportant to the men of the erection crews but one erector is curious enough to read a number of routine items and suddenly finds one item which explains the importance of these records to his satisfaction. Almost illegible due to the layer of dirt from many stubby dirty fingers, that hesitated near the notation, he reads the entry with difficulty. It reads; "Started No. 3 boiler feed pump at 3:04 p m. Lost suction. Shut No. 3 boiler feed pump down at 3:10 p m, due to leaking packing glands which could not be adjusted." As the erector turns away he recognizes the importance of the log book but he does not realize how effective its use can be. Three or four men have copied this notation in their memo-pads and repair crews are already working to replace the packing glands on No. 3 boiler feed pump.

The service engineer, his clothing covered by white smudges which indicates that his bed has been a pile of insulating boxes over in one corner of the the boiler room, is drinking coffee near the boiler control panel. He is sitting on an old box with his back to the burner windbox to chase some of the chill dampness from his tired body. A new day has started for this man and the coffee which seems to be the universal prescription for tired aching bodies around a power plant, is a welcomed substitute for breakfast.

After drinking his coffee and talking to his relief engineer and the boiler operator the service engineer makes a tour of inspection up, over, down and around the boiler unit. He examines flame and furnace conditions and ash collections at the various inspection doors. His ears now attuned to the normal noises of operation are listening for the faint yet unmistakable hiss of escaping steam which he knows would indicate a leak in the boiler unit. He examines several thermometer wells in the economizer and superheater headers, the location of which he had noted before starting up, but he finds no evidence of leakage. Several drain valves are dripping water indicating that the packing glands need tightening and he makes a note of these so they may be reported to the maintenance crews for adjustment as soon as possible. He notices one casing expansion joint which seems to be holding up and is causing a plate to buckle. He borrows a hammer from a nearby workman and with several sharp blows causes the plate to spring into place and the interference seems to be eliminated. Fan and pump bearings are running smoothly and are barely warm to his hand. One of the pulverizers seems a little noisy and he makes a mental note to complete the coal feeder controller settings that day so that coal feed and pulverizer loading will be correct for the air flow through the mill.

He is finally satisfied that operation in general is satisfactory and he makes his way back to the boiler operating panel where he finds the plant chemist with the first complete boiler water analysis. The dissolved solids are low and the phosphate concentrations are slightly high. The plant chemist reports that the water has a brown, turbid appearance when the sample is being secured and the suspended undissolved solids seem to be high. After some discussion it is decided that the unit will be blown down on a four-hour schedule

In the February issue, the author described the various steps involved in placing a large steam generator in service. Now, in another article, Mr. Gore relates what happens during the first few days and weeks of operation. He describes how the erection men watch every detail, how they work with the operators to see that everything is done correctly, what precautions to observe in blowing soot, in operating the blowdown valves, etc. In short, Mr. Gore makes the reader live every moment of the first tense days and weeks of operation. In this present article, Mr. Gore carries you through the first full day of operation; in a second article he will describe what happens in the operation of this unit in the following six weeks

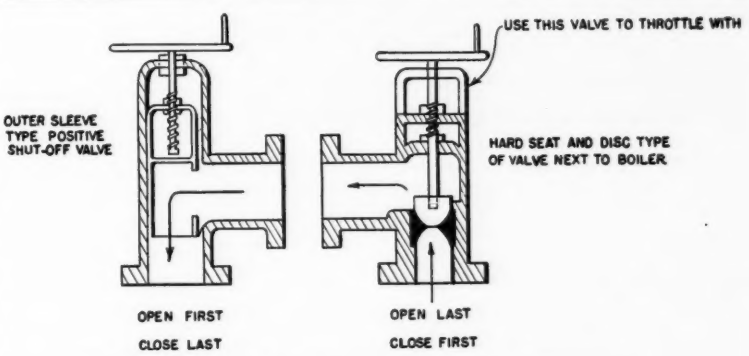
until the majority of this turbidity has disappeared.

The boiler operator is informed of this decision and he carefully makes a note of these instructions in the log book thus establishing the blow-down schedule. The service engineer and the operator's helper are already on their way to the basement where the blow-down valves are located. The service engineer quickly instructs this man in the methods to be followed in handling the blow-down valves. Each downcomer has a set of blow-down valves as do the lower furnace sidewall headers. The service engineer cautions the helper, telling him that the furnace sidewall header blow-down valves should never be opened while the unit is being fired. If an occasion should arise when it was felt that the lower headers should be blown to eliminate sludge or dirt, this should be done at extremely low firing rates and care should be taken not to blow these valves too hard or too long even under such conditions. The use of these blow-down valves during normal operation may rob the furnace wall tubes of water or interrupt normal circulation through these tubes thus causing them to overheat and fail. These valves should be kept locked closed and should only be used to blow the headers clear after firing has been discontinued especially when the boiler is being taken from service.

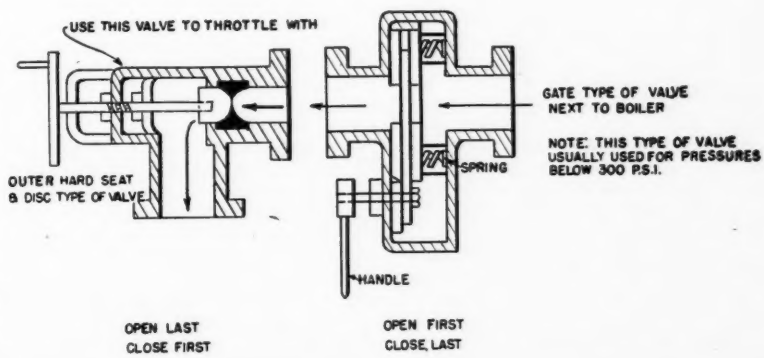
The blow-down valves on the downcomers however, are to be used for the regular blow-down schedules during service which will probably be established on a 24-hour basis or at even longer periods as this unit uses all evaporated water or condensate and very little sludge is anticipated. These are the valves which will be used to reduce the boiler water turbidity which should clear up in a few days as a great deal of suspended matter will settle in the downcomers and can be blown from the unit. The service engineer, continuing his instructions, explains that the two valves on the blow-down line are of different types. The inner valve next to the boiler is a hard seated plug type of valve while the outer is a sleeve type of valve in which the packing is not tight unless the valve is fully open or closed. The inner valve is used to throttle the flow and is designed and built to resist wire-drawing while the outer valve gives a positive leak-proof seal when the blow-down valves are closed. The outer valve is to be opened first and then the valve next to the boiler is to be opened slowly thus throttling the flow of water from the unit. The helper follows instructions opening the outer valve wide and then opening the inner valve. The inner valve is opened slowly to prevent water hammer and vibration of the blow-down piping which is subjected to a sudden temperature change and shock from the sudden inrush of hot water and steam. The service engineer has stationed himself on the steps where he can watch the operator and after the inner valve has been opened wide for about 30 seconds he signals to the helper to close this valve. The boiler operator has signaled that the water level in the top drum has dropped about one inch. The inner valve is closed first and then the outer sleeve type valve is closed. This procedure is repeated on the other downcomer and after making sure that all valves are closed the service engineer and helper go back up to the operating control panel.

How to Operate the Blowdown Valves

The operator's helper then tells the service engineer that this method of operation of blow-down valves does not correspond to what he has been shown on other boiler units and he wonders if the valve opening procedure outlined is

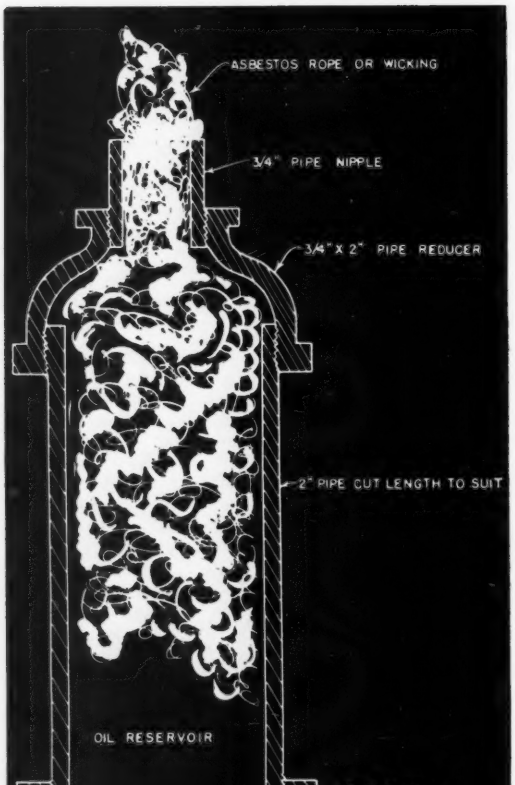

USE THIS VALVE TO THROTTLE WITH
OUTER SLEEVE TYPE POSITIVE SHUT-OFF VALVE
HARD SEAT AND DISC TYPE OF VALVE NEXT TO BOILER
OPEN FIRST
CLOSE LAST
OPEN LAST
CLOSE FIRST

OPERATION OF SLEEVE TYPE BLOWDOWN VALVE ASSEMBLY


USE THIS VALVE TO THROTTLE WITH
GATE TYPE OF VALVE NEXT TO BOILER
NOTE: THIS TYPE OF VALVE USUALLY USED FOR PRESSURES BELOW 300 P.S.I.
SPRING
OUTER HARD SEAT & DISC TYPE OF VALVE
HANDLE
OPEN LAST
CLOSE FIRST
OPEN FIRST
CLOSE LAST

OPERATION OF SWING GATE OR PLUG COCK TYPE BLOWDOWN VALVE ASSEMBLY

Fig. 1. Operation of two different types of blowdown valves



Note: Fill reservoir with kerosene or light fuel oil. Light exposed end of wicking. Hold flame near suspected air leak. Leak will be indicated if flame is pulled into boiler setting by draft. The magnitude and extent of the air leakage can also be determined by an experienced operator. When fabricating torch use standard pipe fittings of sizes indicated

Fig. 2. One of the most important tools in a power plant. It is a torch for candling boiler setting in order to determine the location and extent of air leakage

correct. The service engineer carefully listens to the comments of the operator's helper knowing that these comments are also correct and important. The helper states that on other boilers in the plant it is customary to open the valve next to the boiler first and to then open the outer valve using it to throttle the flow of water and steam from the blow-down. The outer valve is closed first and this is followed by the inner valve. This procedure as explained to the helper allows the outer valve to take all the wear and the throttling or wire-drawing action of the water and flashing steam. If the seats or plug disc is cut in the outer valve by this action it can be removed at anytime for repairs. The inner valve which is not subjected to this wear can be closed thus allowing the outer valve to be removed for repairs while the boiler continues in service.

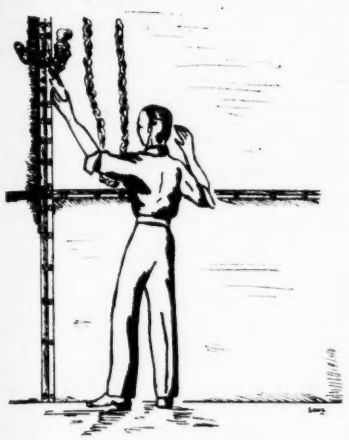
The service engineer then explains that this method is also correct and that the difference in procedures is due to the kinds of blow-down valves used. If a swing gate or plug cock type of quick opening valve is used, it is placed next to the boiler. The hard seated plug type of throttling valve is then placed down stream from the first valve and is used for throttling the flow. In such an arrangement the inner valve is opened first and closed last. The outer valve does all the actual throttling and as the operator's helper has stated, this is an advantage because this valve can be repaired without removing the boiler from service. The sleeve type of shutoff valve is not used in this manner due to the fact that the packings are not tight until the valve is fully opened or closed and packing leaks would occur if this valve were under boiler pressure when only partly open. However this seatless sleeve type of valve does give positive shutoff and is preferred by some operators for this reason as a leaking blow-off valve can be very serious if not discovered.

The service engineer thanks the helper for calling this conflict in operating procedures to his attention, and to prevent any further misunderstanding he writes up instructions on the blow-down valves and leaves it in the log book for the night crews. The service engineer hardly finishes this task when men from the Results Engineering Department appear at the boiler operating panel. They have been instructed to contact him and they wish to know what orsat or gas analysis tests are desired. After some discussion it is decided to ignore any possible air leakage through the setting and to run orsat checks between the economizer outlet and air heater inlet where gas sampling tubes have been arranged to secure a composite gas sample from the entire area of gas flow through this section. The service engineer follows the test crew to the location of the manifold connecting the various sampling tubes and in a few moments a composite gas sample is aspirated or drawn for use in the orsat. The test crew is familiar with this sampling manifold as they have spent many hours previous to the starting up of the boiler unit adjusting the needle valves in each individual sampling tubes so that the gas flow from the individual tubes is approximately the same for the flow conditions under which the sample is aspirated.

The initial orsat check shows an excess air content in the flue gas of from 30 to 35 per cent which is about 10 per cent too high. The service engineer seems to be satisfied however and states that this is sufficiently accurate for a preliminary setting of the steam-air flow meter. He asks the test crew to take gas samples of the gases entering the superheater section as he believes that a great deal of the excess air shown in the gas analysis may be due to setting and casing leaks ahead of the economizer. The test crews grumble a little as they leave to secure the necessary water cooled gas sampling tube to be used in location where gas temperatures are high. The very thoughts of manipulating a heavy hot tube with water supply and drain hose attached to the outer end is not too pleasant to these men who have done this job innumerable times before.

While the test crews are making the necessary arrangements and securing the requested gas analysis the service engineer spends several hours checking coal weights and setting the feeder controllers on each pulverizer. In order to do this he asks the turbine operator and the load dispatcher for additional load so as to increase steam flow from the boiler. He has the boiler operator place the second pulverizer in service and after assuring a pleased load dispatcher that he will hold the additional load for a number of hours, he proceeds with his adjustments of feeder controllers. With two pulverizers in operation he can vary the load from one mill to the other and by thus shifting load he can determine the actual operating conditions for various air flow conditions through the pulverizer. He quickly plots these points on a curve showing the correct coal loading ratios for the given air flows and the feeder controllers are adjusted so these points fall on the curve indicating proper and correct fuel loadings for the pulverizers at various load ratings.

The test crews from the Results Engineering Department have completed a number of gas analyses and they report that the excess air of the gas stream into the superheater is 8 to 10 per cent lower than that leaving the economizer. This confirms the service engineer's suspicions of air leakage



Testing for air leakage

through the casing and setting between the furnace outlet and the air heater inlet. The test crews are then instructed to use the gas analyses taken at the superheater inlet for preliminary settings of the steam-air flow meter so a combustion guide will be available for the boiler operator until a correct setting of this meter can be made after the air leakage has been corrected.

The service engineer stops to talk for a minute with one of the erection crew who happens to be passing by the operating panel. Some time later the head erector shows up at the operating panel as word has somehow reached him that the service engineer would like to talk with him. After talking about a number of unrelated items for several minutes the service engineer finally asks the erector to have his men go over the setting and steel casing and to seal up any air leaks which may be found. He has some difficulty in convincing the erector that such a procedure is necessary and eventually he has to give the erector an order to cover the cost of the labor necessary to inspect for and seal off air leakage. The erector finally agrees to candle each casing joint and any other spot where air leakage is likely to be found such as along expansion joints, corners, drum ends and headers. He also agrees to seal off any such leakage by seal welding where possible or by caulking the openings and cracks with asbestos rope or dum-dum which is a black viscous mixture of asphalt and asbestos sometimes known as boiler seal. The erector shakes his head in a puzzled fashion as he walks away and he is also muttering that he cannot understand what all the fuss is about when it only involves a few small air leaks.

Air Leakage is Important

The service engineer is not alarmed by the erector's lack of enthusiasm as he knows that the work requested will be done. He also knows that it is necessary as he has seen too many boiler troubles which have resulted from the simple problem of air leakage. Too many times the boiler operator overlooks the simple solution to a number of operating problems by ignoring air leakage but the service engineer knows it to be one of the most important problems in the boiler plant. It may manifest itself in various forms such as poor combustion and furnace conditions resulting in increased carbon and unburned combustible losses; poor burner ignition resulting in unstable operation; preignition of fuel in burner due to too low secondary air-flow through burner; excessive furnace slagging, high or low superheated steam temperatures; high air heater and economizer temperatures; excessive draft losses; overloading of induced draft fan; excessive erosion and cutting of metal and refractory parts by fly ash and many other troubles which can result as a combination of the above factors.

The service engineer with memories of slag conditions which seemed beyond control and of burners warped and twisted due to overheating or preignition of the coal in the burner, cannot forget that these troubles are often traced back to air leakage. The air should be admitted through the burners or the stoker under the control of the operator and never by leakage which is uncontrollable. Burners, stokers and boiler furnaces are designed on the basis of handling a definite volume of air and if this air is leaking into the setting beyond the furnace then operation is poor and any number of major problems are likely to show up. If air leakage is suspected an orsat analysis should be made at various locations to determine the air leakage and in no case should air to the furnace be reduced on the basis of orsat test at the economizer or airheater outlet when furnace conditions indicate too little air by visual inspection. Smoke is also an indication of too little air and if smoke is visible leaving the stack the furnace needs more air and the orsat or gas analysis can then be very misleading due to air leakage. The small oil torch used to candle the setting to determine air leakage is one of the most useful tools that is available in the boiler plant but because it is simple, inexpensive and requires constant use by a conscientious well-trained man, it is often neglected and not used.

Do Not Operate Soot Blowers Below 25 Per Cent Load

It is now nearly noon and the day operating crew is now on hand ready to relieve the night crew for the next 12-hour period. The service engineer considers this an ideal opportunity to instruct both crews in the proper procedures to be followed when blowing the soot blowers. With this in mind he inspects furnace conditions and burner ignition. The furnace is clear and the burners are showing some evidence of ash or slag collections around the burner ports. Burner ignition is stable and the flames are holding close to the burner ports. Two pulverizers are in service with three burners and the load is high enough to assure stable ignition while blowing soot. He cautions the operating crews not to attempt to blow soot on a pulverized coal or oil fired boiler at loads under 25 per cent of maximum steam flow. At such low loads ignition is likely to be unstable and the soot blowers may upset the draft enough to cause loss of ignition momentarily followed by reignition of fuel which will then cause an explosion in the furnace or in a boiler pass due to the carbon particles stirred up by the turbulent action of the soot blowers. The unburned carbon in the ash laying in the boiler and the oxygen content of the flue gases are both likely to be high during low load periods and this increases the seriousness of the explosion hazards.

If soot blowers are to be used during such a low load period every precaution should be taken to maintain ignition and to immediately shut down all fuel firing equipment if ignition is lost. The air flow should be lowered to eliminate any danger of increasing the explosion hazard and the unit should be purged for a period of five minutes to eliminate all combustible gases and suspended fuel from the unit before trying to light off the burners after such a loss of ignition. The service engineer promises to tell the operators more about this purge period at a later time and he only has one or two further remarks to make on soot blowing. He states his belief that the safest procedure is to avoid blowing soot at loads below 25 per cent of maximum rating and he also believes that if a rule to this effect is made and enforced, the soot blowing will be found to be unnecessary below this rating. He also cautions the operators to never use soot blowers on a boiler unit which is out of service unless a period of 16 hours have passed since the shutdown. The explosion hazards due to the stirring up of hot or burning carbon or soot particles is too great to justify the use of soot blowers on a unit which is out of service for only a short period of time.

Operating the Soot Blowers

The operating crews especially the night men, are too tired to listen to much more in the way of verbal instructions and the service engineer turns and asks the operator to place the furnace draft controller on remote manual. The furnace draft is then increased to 0.4 or 0.6 in. of water draft and after inspecting the furnace to make sure that burner conditions are still stable, the service engineer takes the available men with him and makes a quick inspection to determine that all the soot blowing valves are closed and that all drain valves on the soot blower piping are open. He then proceeds to the valve in the steam supply line and slowly admits steam to the soot blower piping. The open free blow-drains immediately begin blowing steam but he waits until the steam blowing from the drains shows no evidence of moisture or condensate before closing the valves. He explains that even a faint trace of

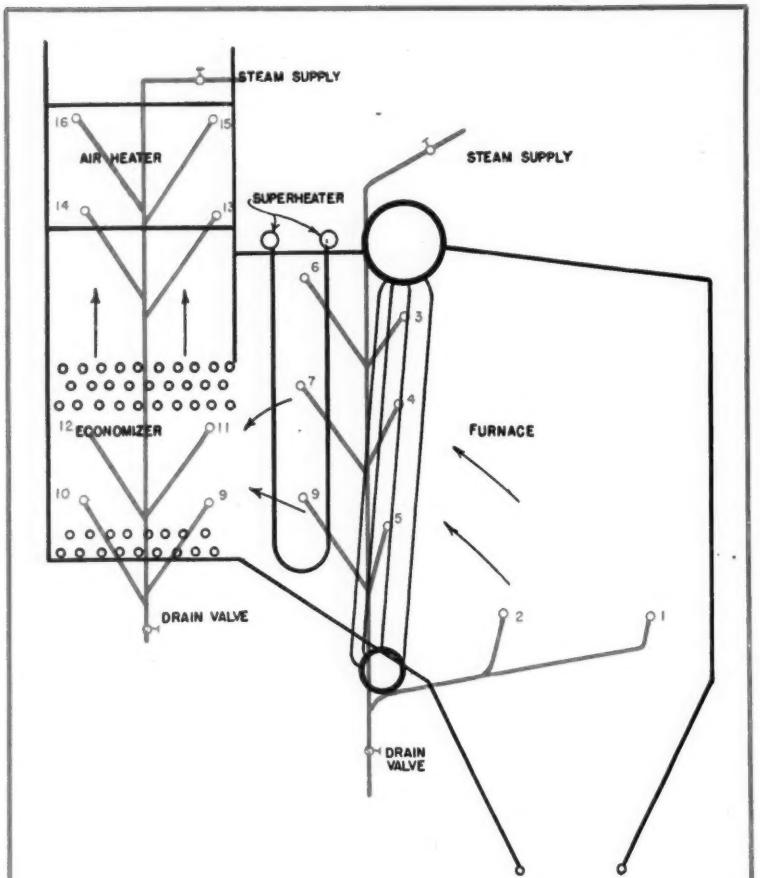


Fig. 3. Soot blowing instructions
1. Put furnace draft in manual control. Increase furnace draft to 0.4 to 0.6 in. of water
2. Make sure that all soot blower piping drains are open
3. Admit steam to soot blower piping
4. Warm up piping and drain off all condensate
5. Close drains
6. Blow soot blowers in order indicated above. Blowers to be operated following direction of gas flow as indicated by arrows
7. Close off steam supply when blowing is complete
8. Open all drain valves

moisture is undesirable and that such moisture if blown into the hot soot blower cleanout in the boiler will cause a quenching action on the metal which will seriously damage the element. Even after closing the drain valve, steam in reduced volume continues to blow from the drain and the service engineer explains that the valve disc has a ⅛ in. diameter hole drilled through it. The purpose of this small hole or orifice is to drain or eliminate any further collection of moisture which may occur after the drain valve is closed. It also serves to eliminate any moisture which may occur due to a leaking steam valve when the soot blowers are not being used. He also explains that this small drain hole has some value in case the operator forgets to open the drain valve as it will eliminate at least part of the condensate formed when warming up the soot blower piping. He cautions them however that the small hole is not to be depended on for this purpose as it is too small to allow all of the condensate to escape during such a warming up period and the drain valves should be opened wide.

With the preliminary draining and warming up of the piping complete, the service engineers tell the operator's helpers how to use the telescopic furnace blowers. He does not know exactly what effect these furnace wall blowers may have on burner ignition and anticipating the possibilities of trouble he wishes to be at the operating panel during the use of these blowers. He signals from the panel board indicating that the operator's helper selected to operate the first telescopic blower, is to go ahead. The high pitched shrill whistle on the blower heads screams a warning and indicates that the steam entering the blower is free of moisture by its very tone. The service engineer turns quickly to watch the furnace draft gage. The pointer on this gage plunges madly up and down as the blower head is slowly revolved. As the blower blows toward the burners the burner ports darken indicating poor combustion but ignition is maintained and the furnace draft swings to a positive or suction value as the blower head turns and blows in the direction of gas flow and finally shuts off. The boiler operators who have never seen telescopic lance type blowers in operation, are dismayed by the change in furnace conditions during the blowing cycle but the service engineer quickly tells them that he will have smaller orifices installed at the blower heads which will restrict the steam supply so that these blowers will not be so upsetting to normal operation.

The use of the furnace wall blowers is continued until each blower has been operated three of four revolutions. No loss of ignition occurs and the service engineer then goes back to the soot blower locations and shows the men there how to use the standard revolving type of elements. The superheater section is then blown each element being turned slowly through three of four complete revolutions. Following the direction of gas flow, the entire boiler, economizer and air heater, are blown clean. The operators at the boiler panel hear the soot blowing crew proceeding further and further from the furnace and are pleased because the blowers in the back passes causes very little fluctuations in furnace draft.

The shrill scream of the whistles finally ends and the operators know that the soot blowing is complete. The service engineer appears briefly at the operating panel and requests that the furnace draft be lowered to 0.3 or 0.4 in. of water. He then takes the men available down into the basement where they sluice all the ashes from the ash pit. When the ash pit is clean, the hoppers under the economizer, air heater and dust collectors are also cleaned. The service engineer finds some evidence of smoldering fly ash deposits in the hoppers under the dust collector and notes that the hopper bottoms seem unusually hot. The deposits of black carbon which he notices in the ash are not uncommon during the initial starting up period and are due to poor combustion. They frequently result in intensely hot fires in the ash collecting hoppers and the service engineer is therefore pleased to get this material out of the hoppers before any damage has been done. He also makes a mental note to pull the ashes from the dust collector hoppers before blowing soot on the next unit which he starts up so as to eliminate the possibilities of stirring up such burning ash deposits and causing an explosion during the soot blowing period.

With the boiler unit now clean, he goes back to the operating panel and has the operator reduce the furnace draft and place the furnace draft controller on automatic. It is now nearly 1:00 p m and the tired night operating crew leaves the plant. The day shift

(Continued on page 130)

The PRACTICAL ENGINEER *and* ELECTRICIAN

ANDREW W. KRAMER, EDITOR

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BEWARE ENTHALPITIS!

In bygone days, it was customary to compare a reciprocating engine ship having a good fuel rate with a turbine ship having a poor fuel rate, and thus prove that the old fashioned engines were more efficient. However, the war put into service large numbers of turbine driven steamships having identical power plants, and it was soon noted that some of these ships showed fuel consumptions as much as 20 per cent more than others. This only proved the importance of good operating methods. It revealed that large savings can be made merely by paying attention to such matters as clean boiler tubes, the correct quantity of air, and the prevention of air and steam leaks, any one of which may cause 5 per cent loss of efficiency. This common disease of power plants, burning too much fuel for the power produced, is called by General Electric engineers "enthalpitis." It can be cured in short order by the application of appropriate remedies.

A Section of Power Plant Engineering Devoted to
PLANT OPERATION AND MAINTENANCE

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Boilers For Power And Process Loads In Small Plants

Present high cost of fuel and labor makes efficiency in steam generating units of high importance . . . Using HRT boiler as a base the author analyzes the initial costs and operating costs of ten types of small, standard boilers . . . Other special design units considered . . . Governing factors in selection of fuels discussed . . . Effects of feedwater analysis and necessary treatments on selection of boiler

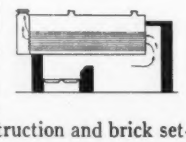
By **WILLIAM W. GAYLORD**, Consulting Engineer

MANY OF the smaller industrial plants have steam requirements for power or process in addition to building heating which calls for steam at a pressure of from 50 to 150 psi where the maximum demand for steam runs from 5,000 to 15,000 pounds per hour. In many places the steam is now supplied by old hand-fired units which are inefficient and require expensive attendance to keep them in operation. With the present high costs for fuel and labor the question of replacing these with more efficient units mechanically fired is bound to come up as soon as materials are available.

This brings up the question of units now available for this service and a comparison of their advantages and disadvantages and their relative costs. Both fire-tube and water-tube boilers in several types are available and can be equipped with either automatic oil burners or stokers. Within the last few years the so-called Packaged Type Boiler has been developed and given considerable publicity. These are mostly of the fire-tube type of modified "Scotch" design to give three or four passes to the products of combustion but a few have been built in the water tube type and some of these have forced water circulation. All are oil or gas fired and have burners built into the unit. The published ratings are all maximum ratings (based in most cases on 5 sq ft of heating surface per horsepower instead of the 10 sq ft used in rating other boilers) so that this must be taken into consideration in choosing the size of these units.

Before discussing further the choice of units it seems desirable to review briefly the principal types available. Taking first the fire tube type, these are:

1. The Horizontal Return Tubular Boiler

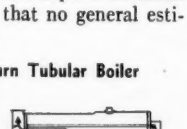


This can now be obtained in welded construction with steel cased insulated settings as well as conventional riveted construction and brick setting.

As this is the type of boiler that has been most widely used for this service a modern welded unit installed in a good brick setting of ample height, not insulated or steel cased, and equipped with a fully automatic burner for heavy oil with suitable fuel tanks, pumps, preheaters etc. will be taken as the standard to which other designs will be compared. To simplify these comparisons assume the cost of this unit as 100 per cent and the annual fuel required for a given load 100 per cent. The cost of this boiler in a steel cased insulated setting would be about 110 per cent and the fuel required about 98 per cent. The same boiler in a brick setting and equipped with underfeed stoker and automatic controls, but without coal and ash handling equipment, would be about 68.5 per cent and the fuel required 104 per cent.

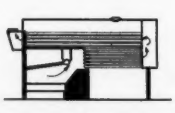
The cost of coal and ash handling equipment, if any, will depend so much on local conditions that no general estimate would apply.

2. The Two-Pass Return Tubular Boiler



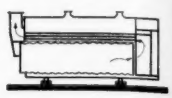
This is made in a number of forms and can be obtained in welded or riveted construction with or without steel cased insulated settings. Some have been built with water walled furnaces. The cost of this boiler in a steel cased, uninsulated brick setting and equipped with the oil burning system as above would be about 89 per cent and the fuel required about 102 per cent. The cost of this boiler with underfeed stoker would be about 58 per cent and the fuel required about 107 per cent.

3. The Firebox, Double-Pass, Fire-Tube Boiler



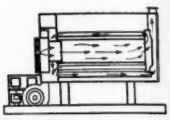
This is a compact self-contained unit but has large surfaces supported by stay bolts. The cost of this boiler equipped with oil burning system as above would be about 86 per cent and the fuel required about 104 per cent. The cost when equipped with underfeed stoker would be about 55 per cent and the fuel required about 108 per cent.

4. The Scotch Type, Fire Tube Boiler



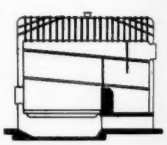
This is also a self-contained unit and gives good results with gas or oil firing, but the furnace space is so limited that it can only be used with coal burning equipment at materially reduced capacities. The cost of this boiler equipped with oil burning system as above would be about 88 per cent and the fuel required about 104 per cent.

5. The "Packaged" Fire Tube Boiler Burner Unit



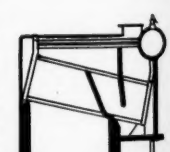
This boiler is of the Scotch type but built with smaller tubes and arranged to give three or four passes to the gases. It is equipped with a forced or induced draft fan to take care of the high draft loss caused by the small tubes and extra passes. Boiler, burner, fan and controls are all mounted on a steel frame so the unit can be shop assembled, adjusted and tested. It can be used only with oil or gas fuel. As these units are designed to operate at maximum capacity they will not carry heavy overloads of even short duration. The cost of one of these units with oil tank and oil piping equipped to burn heavy oil would be 93.5 per cent and the fuel required 98 per cent.

6. The Firebox Type Water Tube Boiler



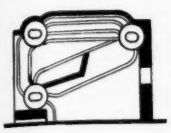
This is also a self-contained unit that requires no brick work except for bridge wall and lining of combustion chamber. It also has large surfaces supported by stay bolts. The cost of this boiler equipped with oil burning system as above would be about 94.5 per cent and the fuel required about 98 per cent. The cost equipped with underfeed stoker would be about 86.5 per cent and the fuel required about 100 per cent.

7. The Water Tube Boiler with straight inclined tubes and either box or sectional Headers



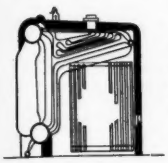
This is a standard type of water tube boiler in a good brick setting, not steel cased or insulated. The cost of this boiler equipped with oil burning system as above would be about 117 per cent and the fuel required about 98 per cent. The cost equipped with underfeed stoker would be about 85 per cent and the fuel required about 100 per cent.

8. The 3 Drum Low Head Water Tube Boiler



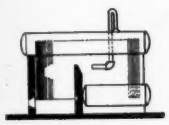
This is a standard type of bent tube, water tube boiler in a good brick setting, not steel cased or insulated. The cost of this boiler equipped with oil burning system as above would be about 114 per cent and the fuel required about 100 per cent. The cost equipped with underfeed stoker would be about 83 per cent and the fuel required about 104 per cent.

9. The Integral-Furnace, Two Drum Water Tube Boiler



This is a modern design with water-walled furnace and insulated, steel cased setting. The cost of this boiler equipped with oil burning system as above would be about 107 per cent and the fuel required about 95 per cent. The cost equipped with underfeed stoker would be about 75.5 per cent and the fuel required about 98 per cent.

10. The Two Drum Water Tube Boiler of the Keeler Type CP or similar design



This is another modern design with integral water-walled furnace and insulated, steel cased setting. A unit of this size can be shop assembled and shipped as a unit requiring only the installation of the furnace lining of fire brick after it is set in place. The cost of this boiler equipped with oil burning system as above would be about 100.3 per cent and the fuel burning system as above would be about 100.3 per cent and the fuel required about 95 per cent. The cost equipped with underfeed stoker would be about 69 per cent and the fuel required about 98 per cent.

These comparisons are based on boilers having the same maximum economical steam output rather than on boilers having the same amount of heating surface and the fuel requirements on the heat content of the fuel as fired, rather than the relative cost of coal and oil.

There are also a number of special designs both of boilers and steam generators available that may have advantages in some special cases, but their use is too limited to be included in a general discussion. One of these is a forced circulation steam generator having one drum from which the water is pumped through the water walls and convection surface tubes and returned to the drum for steam separation. This generator appear to have some theoretical advantages where a large amount of steam must be generated in a small space but as yet there is not sufficient data available on the operation of these units under average industrial operating conditions to make a fair comparison between these generators and the more conventional units listed above.

All of the types listed above can be installed so as to give reliable and satisfactory operation but of course there is a wide difference between the cost of and operating efficiency to be expected from a simple firebox, fire tube boiler equipped with a simple underfeed stoker and a water tube boiler with water-walled furnace equipped with a full automatic oil burner and an automatic furnace draft control.

The type of unit that will give the most economical results in any given case depends on the space available for the installation of the unit, the type of load to be carried, the quality of the feedwater, the percentage of feedwater makeup required and the relative coal, oil and labor costs at that particular plant. The first step in every case is to make a careful analysis of the load the unit is expected to carry. This should include the present and any probable future loads for which provision is to be made in the capacity of the unit. The average, maximum and minimum loads and the duration of both the maximum and minimum loads should be carefully determined and the timing and cycle of any major load changes noted. This will determine the capacity required for the unit and the range through which it will be necessary to control the fuel burning equipment.

The next thing to be decided is the fuel to be burned. In these small units it is not usually practicable to equip them so as to burn both coal and oil or to convert from one to the other without considerable expense. Where a reliable supply of oil is available at a price equivalent to that of coal (plus the cost of getting the coal into and the ashes out of the furnace) oil will be found the ideal fuel for these units. On the other hand if oil is not available or the cost is too high a very satisfactory installation can be made by the use of a suitable stoker and the provision of proper equipment for handling coal and ashes.

We are now ready to choose the type of unit and this involves the average annual load factor as well as the space available, the load characteristics and the quality of feed water. If the average annual load factor is high a unit with a high thermal efficiency will be more important than the first cost of the unit, while if the annual load factor is very low the unit with the lowest first cost consistent with reliable operation would be chosen.

If the feedwater entering the unit contains considerable quantities of dissolved oxygen or carbon dioxide this is liable to cause serious corrosion with the water tube units unless a suitable water treatment, proportioned to the rate of feed, is used. This may favor a boiler of the horizontal return tubular type under these conditions as it is less liable to this type of corrosion.

After the unit, auxiliaries and controls most suitable for the particular case have been chosen care should be taken to see that they are properly installed to develop the full efficiency of which they are capable and that the unit receives sufficient attendance to keep it in proper adjustment and efficient operating condition. Al lof the automatic control apparatus should be as simple and rugged as possible, consistent with proper functioning. The attendant who is to have charge of the unit should be thoroughly instructed in its operation and the care, cleaning and adjustments that may be necessary to keep it in good operating condition.

Because of the reliable and economical results that an automatic unit can give when properly installed and operated there seems to be a growing belief among some plant owners that such equipment can be expected to operate without any attention for long periods and still be reliable and efficient. This has in many cases resulted in disappointment. While these automatic units reduce the attention required to a minimum, like all other automatic equipment, they require sufficient attention to keep them in good operating condition and proper adjustment if they are to give entirely satisfactory results.

FAMOUS SILICONES

SILICONES are gradually infiltrating many avenues of electrical apparatus. Best known to electrical men is the use of silicones as a high-temperature varnish for motor windings. The cooperative Westinghouse-Dow Corning motor tests begun in 1943 have verified the fondest hopes as to the performance of silicone varnish. For example, a railway motor after 1700 hr of operation at 285 C (500F) including 46 high-humidification cycles, was torn down for inspection. The motor could have continued to operate indefinitely. The windings were in excellent condition.

While as yet the costs of silicone varnish preclude their wholesale use on rotating machines, they have demonstrated superiorities for high-temperature conditions. They are, accordingly, being used experimentally on railway motors, on certain totally enclosed industrial motors, on magnet coils, for transformers used in street-light fixtures and similar applications. The field for silicone varnishes is definitely growing.

Silcone rubber or gasketing material has proved useful as a cover seal for searchlights where the temperatures created by the electric arc become exceedingly high. This heat resistance without hardening may be utilized in the electric steam iron. A paste of this rubber seals the cover plate to the main base casting. Because the paste conforms to the surface of the metal parts, fine machining of the mating surfaces can be eliminated, yet obtaining even better, longer lasting seals. Washers of silicone rubber in sheet form also find other uses, such as gaskets in electric irons and oil circuit breakers.

Proper Handling of Gas Welding Equipment

The man in charge often has his hands full trying to keep the equipment in shape . . . Cleaning torch tips . . . Proper method of adjustment of connection nuts on welding torches . . . Correct way to adjust gas-oxygen mixture . . . Foreman conducts class

By C. C. HERMANN

THE OBSERVER becomes somewhat confused over what practice might be considered good and what bad in connection with gas welding equipment after visiting a few fabrication shops. It seems as though management sometimes overlooks the fact that the best of tools do not always produce quality output—there must be experience and ability behind the tool.

At one place the welder was trying to open the tip of his welding torch with a piece of wire (Fig. 1) which appeared too large to enter the hole so he was twisting it around and applying all the force the wire would stand. Fortunately for the equipment the department foreman stepped up at about that time and took the torch out of the welder's hand. "Over there in that little rack over my desk you will find a small drill. Just the thing to open clogged tips with. Bring it to me and I'll show you how to do it," the foreman said. A few minutes later the man returned with the drill which he handed the foreman.

"Now watch me," instructed the foreman as he moved the drill into and out of the tip without turning the drill. In a moment he had the tip clean and the workman had gained knowledge which could only be conveyed by an intelligent welder foreman. "Never twist the drill," the foreman instructed. "Just move it in and out like that. In that way the tip orifice is not enlarged or damaged. If you had continued with that wire you were using you would have been turning this tip in at the stock room window now instead of going back to work with a tip as good as a new one."

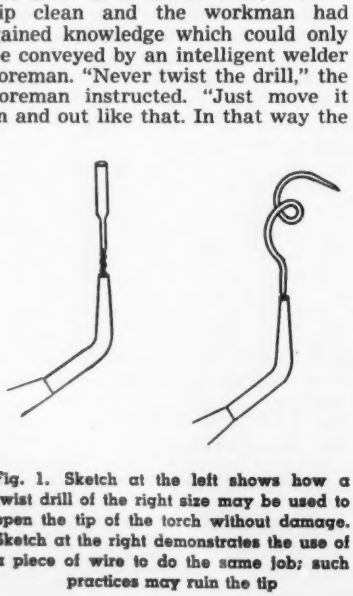


Fig. 1. Sketch at the left shows how a twist drill of the right size may be used to open the tip of the torch without damage. Sketch at the right demonstrates the use of a piece of wire to do the same job; such practices may ruin the tip

Before we had progressed more than a factory bay down the plant the same workman was tugging at the sleeve of the foreman. "Look," he said. "I just received this torch from the stock room this morning and the fittings are so burred up that I can't find a wrench that will fit the nuts."

The foreman took the torch in his hand and turned to me. "I have been in this business since the first gas welding outfit was brought out. I have seen many welders come into the shop and pass on to other shops but I have not seen the last man to tighten the nuts with a pair of pliers instead of the proper wrench. As long as pliers are made these fellows will prefer them to a wrench." Then turning to the workman he continued, "Take this torch back to the stock room and tell the clerk to exchange it for a good one. Tell the clerk, also, to place this torch on my desk."

We walked on a few feet when the foreman turned to me. "In about a half hour we will go into the regular monthly meeting with all the welders in the shop. Would you like to attend this meeting? In these meetings we discuss various problems which the men bring up. It provides a time for dispensing a lot of information which would be otherwise difficult and since you are interested in the proper handling of gas welding equipment I will make that the topic for the meeting. I have a very good example to illustrate and clinch my arguments."

Naturally I was more than anxious to attend the meeting and in due course we entered the conference room where about twenty-five welders and others from the 2nd and 3rd class line were present. It was about the most interesting hour I ever spent. The foreman held up the welding torch which he had brought into the meeting. "Jim," he said, "Is this the tool I instructed you to return to the tool crib this morning?"

"Yes, sir, it is," answered Jim.

"I want you fellows to look at the connection nuts on this torch. This is what they looked like when new, not over six weeks back," and he held up a new torch. "The thing that has happened to the nuts is just this." And he held up a pair of pliers. "In one minute with these pliers I could ruin the nuts on this new torch but by using this wrench, an exact duplicate of the one every man has in his tool kit, these same nuts will last years." He waited a minute for his words to sink in then continued. "This torch represents an expenditure by the company of about ninety dollars. That is ten percent on nine hundred dollars of product. Need I say more on that point?" (See Fig. 2)

The foreman then turned to the damaged torch again. "It appears that in spite of the fact that we have gone over these matters time and again there are still a few men who do not know how to handle the gas welding equipment. For the benefit of every one here I am going over those things again.

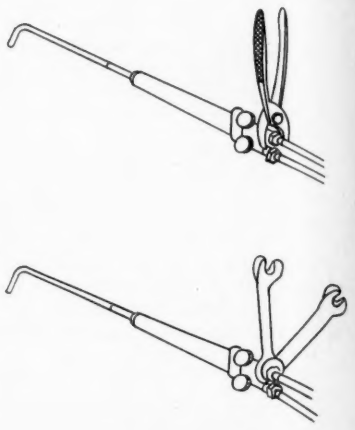


Fig. 2. A pair of pliers is the wrong tool to use when connecting welding hose to the torch. Damage to the fittings will be avoided by use of end wrenches as shown in the bottom sketch

"I took time out this morning to show Jim how to clean the tip of the torch. I want Jim to clean this tip here and now so that those here in the room who do not know how it is done will be enlightened."

Jim proceeded to clean the tip with the drill making it so clear and easy that it seemed impossible for any one to miss gaining the information. Jim sat down.

"Thank you, Jim," said the foreman. "Now I want Bill to show us how the slouchy welder does the same operation. Take this old torch, Bill, which I have had connected to the tanks and while you are at it show us how the novice goes about the job of regulating his torch."

Bill took the torch, stepped over to the regulators and made a quick adjustment, then lit the torch. He stood there working with the gas valves on the torch. "I am trying to adjust the mixture here at the torch instead of at the regulator," he said. "You must agree with me that I am having quite a time doing it. In fact, it is next to impossible to get a flame which can be accurately controlled

in this manner. Now by properly adjusting the regulator and then making just a slight final adjustment at the torch you notice that I have a swell welding flame almost immediately. The answer is, never depend on the torch valves for regulation which is strictly a function of the regulator set."

Bill looked at the tip of his torch. "Hello," he said. "There is something wrong with this tip. It needs a thorough cleaning. This is the way the novice would do that job," and he reached for a brick which he laid down flat on the floor and then raked the tip across the face of the brick a few times. He then held it up and showed how the flame was flattened out. "That is entirely wrong," he remarked. "Turn off your torch and go about the job like Jim indicated a while ago," and he proceeded to clean the torch in the proper manner. "Now light it again and you have a swell working torch out of this old wreck. Now to shut down the outfit for a brief time merely turn off the gas at the torch but if for and indefinite length of time always turn off the gas at the regulator, being sure it is closed tight."

"Thank you Bill," said the foreman as he dismissed the meeting and every one went out with a clearer idea of how to handle the equipment.

BONEHEAD PLAYS

Here are the outlines of a few bonehead plays, some dangerous, some potentially so if not caught in time, others more in the line of stupid sabotage

By H. B. McDermid

1. WHY THE sales engineer left hurriedly. A dumb foreman bragged that the cast iron radiator under his table was continually carrying 125 lb boiler pressure, when the S.E. knew the type was ordinarily built for a maximum pressure of 10 lb. If the foreman was not kidding, why no burst?

2. Nearly a full barrel of dirty naptha in an open container was sent to the highly overloaded boiler fire room for disposal, without notice, just ten minutes before a long holiday shut-down was due to start.

In a wood working plant, housed in old wooden buildings, saturated with oils and dry as a tinder box, what would you do with a fire bomb like that on desperately short notice?

3. A graduate engineer, on his first job, hitches 110 psi air pressure to the bung hole of a steel barrel, to increase the flow of 600 W cylinder oil on a near zero day in a store room crowded with small parts in hundreds of small bins. He got the faster flow all right as both heads blew out—After twenty years it still causes a headache to think of that mess!

4. A graduate engineer on another first job had a chain drive give up after wearing out and finally pulling the sprocket teeth from the sprockets from serious overloading. He was young, cocky and confident and prescribed two "B" section Vee belts, running at the same speed as the chain, to drive the shafts and cure the trouble.

Was his face red, when he watched his two little belts pull relentlessly in two, before they even once started the load, while the mill-wrights who had protested the change as far as they dared stood by and watched?

5. A brand new load capacity concrete mixer used occasionally for odd jobs was left at night at the finish of one pour full of concrete. It was not discovered by the Superintendent until it was needed for another job. It had to be salvaged, but was that a job, with sledges and concrete points, to chip out that fully hardened 3500 lb of concrete?

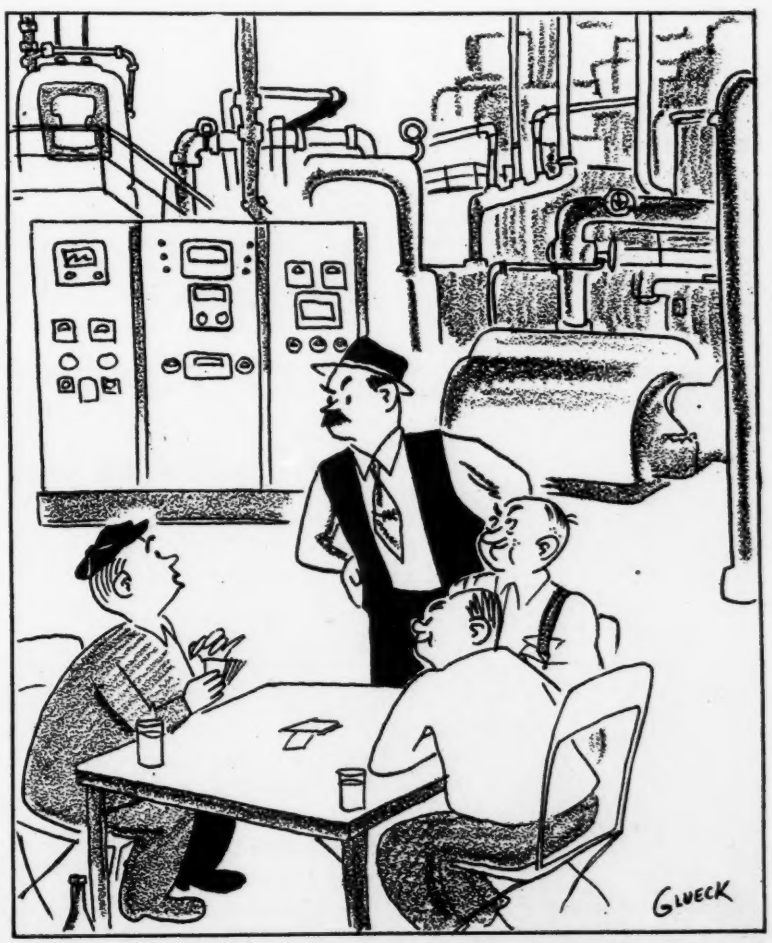
6. A steam engine driven concrete mixer, had its boiler, a 15 hp vertical outfit retubed after an unusual amount of trouble. It was placed on its foundation and the job fininshed just at dusk of a winter day. The mechanic in charge of the job went home feeling relieved that the job was in dandy shape. Within an hour after the night shift of laborers had come on shift they had dry fired that boiler to have a place to get warm. Imagine the feelings of the mechanics when their first job next day, was to dismantle that boiler take it a quarter mile to the shop and do the job over again!

HOW ELECTRICAL MACHINES FUNCTION—CORRECTION

WE WISH to call attention to a rather serious error in Part I of R. Andriessen's article "How Electrical Machines Function," which appeared in the February issue. On page 96 the captions for illustrations Fig. 10 and Fig. 11 should be interchanged. In other words the caption for the illustration in the first column should read "Here the machine is equipped with a commutator," while the caption for the illustration in the second column should read "Wave form of current in the armature of a machine not equipped with a commutator."

It will be evident that the curve in Fig. 11 as shown is not that of a machine fitted with a commutator.

The author has also called attention to an error in column 3 on page 96. The last sentence of the second paragraph of column 3 contains an error in that an adjective was made out of what was intended as an adverb. The author meant to say "the voltage would be substantially constant" not that a direct voltage of a substantial value would be obtained.



"Aw—A little pinochle while we keep our eyes on things won't hurt none—."

Heat Insulation Solves Breeching and Boiler Troubles

THE SAYREVILLE PLANT of the Jersey Central Power & Light Co. exhibits two novel uses of insulation with remarkable benefits. These cover the breeching from the discharge point of an induced draft fan to the stack, and the repair of broken and crumbled pressed-block insulation on cross-drum boilers.

The following multiple advantages ensue from the breeching insulation: The breeching no longer requires painting to protect it from corrosion caused by exposure. The gases exhausted through the stack are kept safely above the dew-point of sulphur gases present in the products of combustion. They pass off, therefore, without condensing and corroding the stack inside. The higher gas temperature, further, tends to sustain draft and slightly reduce the power required by the fans. Moreover, it prevents condensation in the air preheaters of acids, which formerly combined with the dust to make a firm binder. This previously occurred at times when the load was light and the temperature fell. Cleaning of the preheaters was inconvenient, laborious, and costly. Neglect of cleaning was worse, for it reduced draft and, therefore, capacity. Finally, the magnetic coupling of the induced draft fans is now protected from disturbances caused by excessive heat, heat developed from contact with hot ambient air in addition to the normal electrically-induced heat of magnetic slippage.

Figure 1 shows the location of the breeching high on the roof of the plant. Insulation consists of 4-inch mineral wool blanket covered with a ¼-in. coat of asphaltic waterproofing. A finish coat is yet to be applied but this will affect only the appearance. The Sayreville plant is located on a coastal plain near the shore, and subject alternately to the full sweep of prevailing west winds and frequent salty winds from the sea. Moreover, salt water is present in the tidal river to the west of the plant. Induced draft fans are located close to the origin of the breeching where it emerges from the roof to approach the stack. The fans are driven through a magnetic coupling. They exhaust gases into the breeching at 300 to 350 F. Uninsulated breeching, especially in this exposed location, would invite a serious loss of heat during the passage of exhaust gases to the stack so that the gases would reach the stack at greatly reduced temperature.

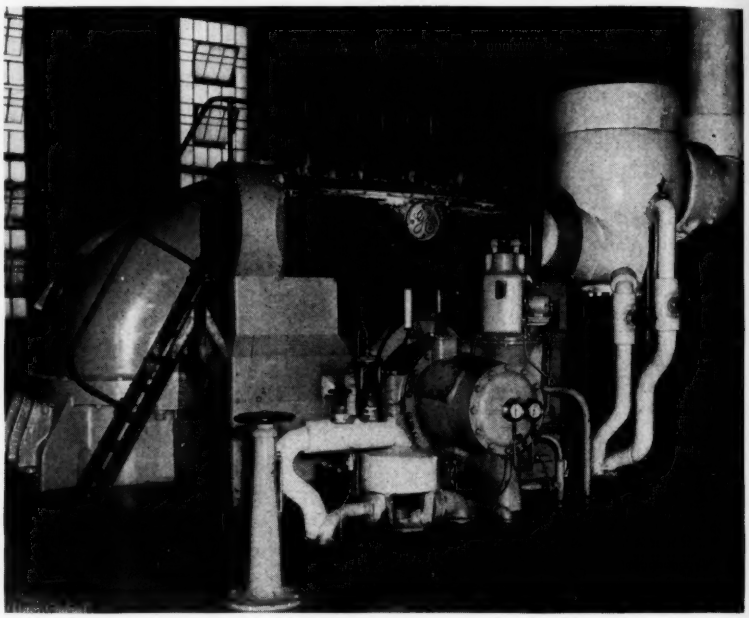


Fig. 1 (Right). Insulated breeching from plant to stack at Sayreville plant of Jersey Central Power & Light Co., sustains temperature of exhausting areas above dew-point of sulphurous vapors present

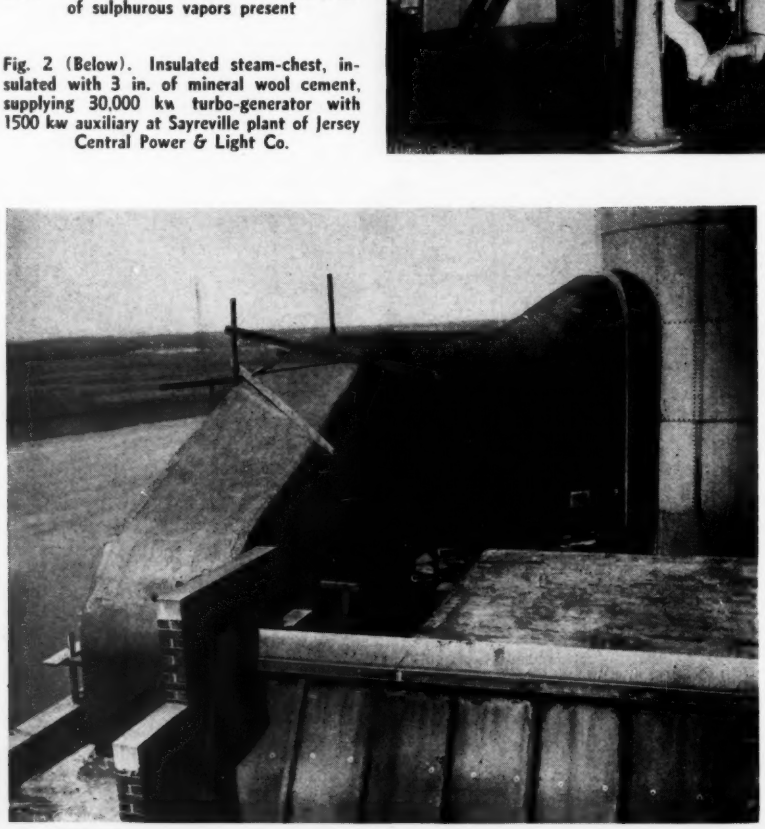


Fig. 2 (Below). Insulated steam-chest, insulated with 3 in. of mineral wool cement, supplying 30,000 kw turbo-generator with 1500 kw auxiliary at Sayreville plant of Jersey Central Power & Light Co.

The heavy mineral wool insulation now protecting the breeching sustains the temperature within the breeching until the hot gases reach the stack so that they do not drop below the dew-point of sulphurous gases until they reach the open air.

The Sayreville plant operates two 30,000 kw main generators with tandem connected auxiliary generators of 1500 kw each for station use. These run at 450 lb pressure, at 700 F. The turbine

Fig. 3. Steam lines and rear water wall of boiler at South Amboy plant of Jersey Central Power & Light Co. First of four to be re-insulated by improved techniques

steam-chests (Fig. 2) are conventionally steel-lagged outside, and further to eliminate heat loss, insulated inside with 3 inches of mineral wool cement. The rear water-wall of one boiler is now being used as a test installation of mineral wool insulation consisting of a 3-inch mineral wool blanket with ½-in. of mineral cement over it. In general, mineral wool is preferred because of its "knit" fibrous structure in addition to its very low "k" factor—but is not yet so widely used in the Sayreville plant as at the South Amboy plant of the same company.

At South Amboy industrial mineral wool blankets and cement are playing an increasingly important part in protection against heat loss. The South Amboy plant is a high pressure station using two 25,000 kw turbines. The high pressure casings of the turbines, operating at about 750 F are insulated with the cement form of mineral wool with the usual steel lagging outside.

The boilers are Babcock & Wilcox high pressure cross-drum type operating at 1400 lb. The original pressed-block type insulation of the water walls of the boilers has been proved unsatisfactory because it is friable and breaks away with time and vibration. Is is being replaced with mineral wool, blankets underneath and cement over the blankets. The entire rear wall of one boiler has been completely renewed in this manner (Fig. 3); another is in process. Elsewhere, breaks in the original insulation are being repaired, as detected, by the insertion of a small block of non-combustible material to act as a support for the remaining insulation in the form of mineral wool cement troweled on to the necessary depth and shape to cover the break.

In addition to the high insulating efficiency attained, this unique repair method offers the advantage of great speed in effecting emergency repairs of boiler insulation, a factor of no little importance with boiler furnace temperatures as high as 2800 F. Steam lines and valve bodies are also generously encased in mineral wool cement for conservation of heat. However, while much emphasis is, of necessity, laid on the value of proper insulation in keeping heat within the lines *for the sake of efficiency,* users are prone to forget the other dangers of imperfect insulation, especially in a high pressure plant where workers may suffer serious burns by accidentally brushing against exposed spots in the lines.

COMMUTATOR SETTING AND CONNECTIONS FOR FRACTIONALS

By C. C. Hermann

THE SETTING of the commutator and making the connections for a fractional horse power motor are a confusing problem to some motor repair men. Unless a very accurate diagram of the connections is made prior to the removal of the old winding or a blue print and specification of the setting of the commutator and the connections is at hand mistakes are very apt to occur. If the commutator has been removed from the shaft for some needed repairs or a new one is to be installed or for any other reason the original setting has been changed the accompanying schematic diagram will be found helpful.

In this drawing are shown the shaft, commutator and rotor intended to apply generally to any fractional horsepower commutator type motor. The relative location of the rotor slots and the commutator mica must be correct. To obtain the corect setting of the commutator the first step is to locate the distance X along the circumference of the rotor. The value of X must be obtained from data supplied by the manufacturer. The center line on the shaft thus found may or it may not pass through the center of the end of a slot as shown in the diagram. It must be noted carefully that the distance X is from the center line of the shaft to the lower side of the rotor slot in exactly the mid-point of the rotor. Having located the line, set the commutator so that this line passes through the center of a strip of mica located between two bars. It does not matter which bars unless two adjacent bars have been marked on the commutator previous to its removal as a matter of balance. Having done this the commutator is properly set for the given motor.

The next step is to number the bars in the commutator from this starting point. Some motors are connected in the Y direction or looking at the shaft end of the commutator, this is in a counter clockwise direction while others are connected in the Z direction or clockwise. This information should have been obtained from the old motor winding or from the manufacturer. Another bit of information which must be at hand, either from the original winding or from the motor specification, is the bar number to which the connection from the first slot is to be made.

Many of the old specifications gave the first bar number only. Later specifications, however, give the bar number for the first lead of each coil in a slot, for instance, in a two coil per slot rotor the specification would be Y-1 which means that the leads from this slot are connected to bars number 1 and 2. For a three coil per slot rotor it would mean that the leads from this slot would be connected to bars number 1, 2 and 3. The leads from the next slot in a two coil per slot rotor would be known as Y-3 and the leads from the coils would therefore be connected to bars number 3 and 4. The work progresses forward to the completion in like manner. Obviously for a clockwise connected commutator the Y in the classification would be replaced by the letter Z. Once the first coils are placed on the right bars the following connections are made in rotation so that it is readily understood that the start must be correct.

Another point which must be given consideration is whether the leads should come out on the back end of the armature or on the front. In general all leads from motors using wire smaller than number 19 come out at the back and larger from the front. Where the leads come out at the back they should be bound down with cord before being brought to the front. They may be brought to the front through any convenient slot for the connection.

It is obvious that the opposite end of the coil must be connected to the bar required to give the correct pitch as indicated in the specification of the winding from the manufacturer or obtained from the data taken down from the old winding.

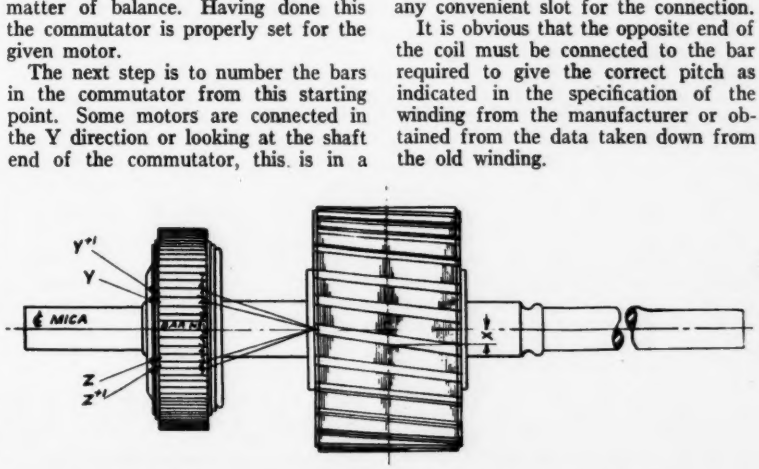


Diagram of rotor showing commutator and its relative location on the shaft

Plaster And Masonry Fastenings

In this article the author describes several well known types of fasteners for use on plaster, masonry, brick, concrete and stone walls, floors and ceilings . . . Location for installation and methods of drilling outlined . . . Necessary precautions, testing of toggles and strength limitations of various types of fastenings are covered

By THOMAS TRAIL

FROM TIME to time the power plant man is faced with the problem of fastening something to a plaster, brick, concrete or stone wall, floor or ceiling. He may have a shelf to install or a workbench to build. The purpose of this article is to explain the different types of fastenings available and which ones he should use for the particular material at hand. It will also point out how these fastenings should be installed and errors to avoid in the work.

Since plaster is probably the easiest material to fasten to we will start with that. Plaster is supported in various ways, usually on wood laths, metal lath or directly on brick, concrete, tile or stone. But for our purpose we will consider only wood and wire lathe since the other types of mounting require the same technique as though there were no plaster coating on the particular materials in question.

Fastenings in plaster are made with special bolts or screws called toggle bolts. As shown in Fig. 1, these bolts are installed by first drilling a hole carefully through the plaster and then passing the hinged or collapsible toggle of the bolt through this hole. As the toggle passes through the wall and reaches the other side it falls or expands across the hole, thus forming a threaded support on the other side of the wall into which the screw can be tightened.

Where the wall to be drilled is of wood lath construction, endeavor to locate the wood laths by tapping lightly upon the wall before drilling. And, if possible, drill the holes between the laths. This will result in an easier and stronger fastening.

If it is impossible to locate the wood laths in this manner, or if the hole position cannot be altered to suit the lath spacing, first drill the holes through the plaster with a masonry or star drill, and then drill through the laths with a regular wood or metal twist drill. Never try to drill through wood laths with a masonry or star drill since this is likely to split the laths and knock them loose from the plaster, resulting in a weakened and possibly cracked wall.

Where wire or expanded metal lath is supporting the plaster, simply drill the holes through the plaster with a star or masonry drill, and then carefully force the drill point through the meshes of the metal lath, so as to clear a path for the toggle to pass through.

When drilling plaster be sure to drill lightly and carefully, striking the drill with very light hammer blows. Rotate the drill a little after each blow. Heavy blows may cause the wall to crack before the drill passes through. Be sure to drill a hole exactly the right size for the toggle to pass through. A hole too small will cause difficulty in installing the toggle, and a hole drilled too large will not provide maximum support for the toggle.

Before installing a toggle bolt, be sure to try the toggle on the bolt to see if it spins free on the threads. The thread in the toggle or on the bolt may be burred or damaged, and this will cause trouble when you try to tighten the toggle bolt in the wall.

When using spring type toggles, be sure to try the spring arms of the toggle to determine if they both will readily spring out into expanded position after the toggle passes through the wall. Any that will not work properly should be adjusted so that they will.

Thread the toggle on the bolt until about there or four threads of the bolt project through the toggle. When passing the toggle and bolt through the wall do not use hammer blows to force it through, as this is likely to strip or damage the threads in the toggle. If the holes have been drilled in the correct position and are of the proper size the toggles should pass through easily.

Tighten toggle bolts moderately. The toggle arms may be damaged or the

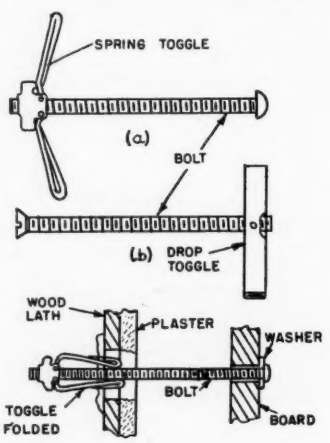


FIG. 1

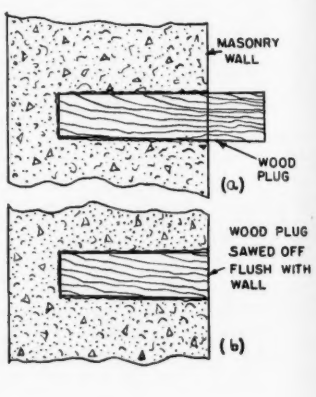


FIG. 2

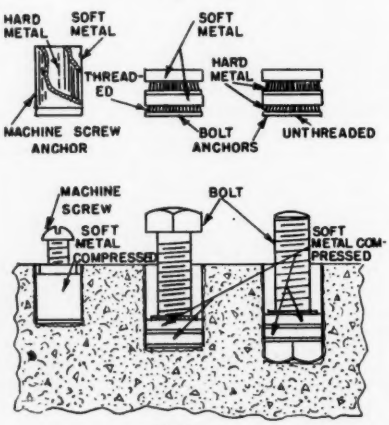


FIG. 3

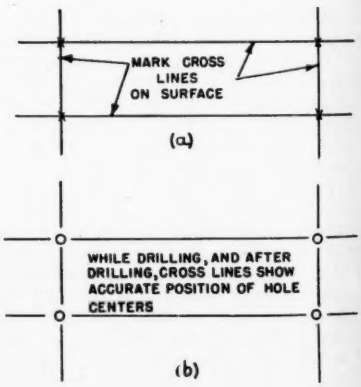


FIG. 4

Fig. 1. Two types of toggle bolts—spring and drop toggle. Fig. 2. Wood plugs should be used only for anchoring light objects which will exert a pull at 90 degrees from the long axis of the plug. Fig. 3. Two types of anchors—machine screw and bolt—and two methods of anchoring with the bolt anchor type. Fig. 4. Proper method of layout for locating centerlines of bolts. This is extremely necessary especially when using anchor bolts of the machine screw or bolt types

threads stripped if they are tightened too much.

Fastenings in brick, concrete and stone are made in several ways. As shown in Fig. 2, probably the easiest and simplest way is to use wood plugs. But this does not produce a very strong fastening and consequently should be used only where light loads are to be fastened to floors and low walls. They may be used under certain conditions in wall and ceiling fastenings, but only where the load is sidewise or 90 degrees to the long axis of the plug and where it is impossible for the plug to come out of the hole. Such an installation would be where a wood partition or wall studding was fastened to wood plugs in such a way that the studding would prevent the plugs coming out of the holes in the masonry.

This precaution is necessary since wood plugs usually shrink after a time and loosen.

Wood plugs should be made of hardwood, if possible, and should be slightly tapered. Their diameter should be at least three times the diameter of the wood screw or lag bolt used, and in no case less than one-half inch in diameter.

Drill the holes carefully with a star or masonry drill, using light to moderate hammer blows, and rotating the drill a partial revolution after each blow. When drilling in brick, concrete blocks or stone try to avoid drilling in seams. If this is impossible, use lighter hammer blows and extra caution to avoid jamming the drill or breaking out pieces of material.

Remove the drill frequently and clean out the masonry dust from the hole. If this is not done the drill may jam in the hole and be very difficult to remove.

The holes should be of such a diameter that the wood plugs will just enter about one-quarter inch, and their depth should be about one inch less than the length of the plugs. But they should always be at least three times the diameter of the plugs.

Remove all dust from the holes and drive plugs in until they rest against the bottom of the holes. Be careful not to split or batter the plugs. Use a piece of hardwood between the hammer and the end of the plugs. When they have been driven tight and solid, carefully saw off the part projecting beyond the surface of the wall with a compass saw or hack saw blade. The use of a regular carpenter's hand saw is not advisable because of the danger of damaging the sides of the teeth on projecting surfaces of the wall.

The screw centers should then be measured and marked on the plugs and a hole drilled for each. The hole diameter should be approximately one-half the diameter of the screw to be used.

A stronger fastening for use in masonry materials is shown in Fig. 3. This type anchor is made in two styles. One is for use with machine screws and the other for use where bolts are to be employed.

In using this type anchor, in the machine screw pattern, a hole is drilled to a depth equal to the length of the anchor. The diameter of the hole should be such as to provide a snug fit for the anchor. If it is too small the anchor will not set firmly all the way to the bottom, if it is too large the anchor will not expand tightly against the walls of the hole.

After the hole has been drilled and the dust removed, place the anchor in position, as shown, with the cone end toward the bottom of the hole. Then, using the special setting tool provided, drive the soft metal sleeve down on the hard metal tapered nut. This will expand the soft metal sleeve and cause it to tightly fill the space between the tapered nut and the sides of the hole, securing the tapered nut solidly in position. Drive the sleeve with only moderate hammer blows. Do not drive too hard or too far as this may destroy the metal. It is now ready for use with a machine screw as a fastening. The screw length should be such that when fully tightened it will not reach the bottom of the threaded hole in the anchor.

The bolt pattern anchors of this type are installed in a somewhat different manner. As shown, they come in two styles. One is used in the same way as the machine screw anchor just described —as a threaded anchor for bolts. The other style has no threads. It is designed for the purpose of anchoring a bolt in a hole, head downward, so that the bolt can be used as a threaded stud.

The threaded anchor style is installed as follows: The first or threaded hard metal insert is placed in the previously drilled hole, as shown, and the threaded guide tool furnished is threaded into this insert. Then a soft metal ring is placed over the guide and allowed to come to rest on the tapered top of the threaded insert. This ring must be inserted with tapered side toward the threaded insert. A short length of proper size iron pipe is then used to expand the soft metal ring against the sides of the hole. Medium hammer blows are sufficient.

Now remove the setting tool (length of pipe) and place another hard metal ring (unthreaded) on top of the expanded soft metal sleeve, adding another soft metal sleeve on top of this. See that the tapered side of the hard metal sleeve is toward the open end of the hole, and that the tapered side of the soft metal sleeve faces the bottom of the hole. Use the setting tool again to expand this second soft metal ring.

The size of the bolt and the holding power desired will determine how many sets of hard and soft metal rings to use. These directions may be found on the box in which the anchors are sold. But in general two sets, as described, are usually sufficient for the smaller sizes of bolts.

When the guide tool is removed the anchor is ready for use with a machine bolt. Use one whose length is such as to prevent its bottoming in the hole.

The second style of anchor is installed as follows: Place the bolt to be anchored in the hole, head downward. Then place a hard metal threadless ring (tapered side away from the bottom of the hole) into place on the bolt. Place a soft metal sleeve (tapered side toward the bottom of the hole) on top of this. Use the setting tool to expand the soft metal ring in the same manner as previously described. The bolt itself serves as a guide in this case. Use as many sets of rings as desired, following the procedure for the threaded anchor.

In mounting any object with toggle bolts, wood plugs or machine screw or bolt anchors, a good layout plan to follow is the one shown in Fig. 4. This will enable you to be able at all times to check alignment. This is especially important when drilling holes, for, unless the position of the hole is checked frequently, the drill is liable to wander, with the result that the hole will be inaccurately positioned. This precaution is very important when installing machine screw or bolt anchors since these often must line up exactly.

It is a good idea to use lock washers wherever possible on screws and bolts of fastenings. They will exert a constant tension, thus helping to prevent loosening of the fastening.

There are a number of other types of fastenings on the market besides the ones described. But the author has used each of the types described and recommends them for practical use in most fastening applications. This should not be construed as a reflection on any type of fastening not mentioned.

SOMETHING BETTER THAN MICA

In 1942 when it appeared that the Japanese might overrun the whole of the South Pacific, engineers were alarmed lest the supplies of indispensable mica be cut off. Although this did not happen, a frantic search began for a substitute for mica, something long assumed to have no alternate. Without mica or an equivalent electrical insulation the electrical industry would have been in a bad way indeed.

A material quite equal to the requirement—and in some ways better—was created by Westinghouse. Asbestos paper was impregnated with a thermosetting synthetic binder of the Fosterite family molded to the desired shape, and cured under heat. The resulting insulation, while by no means a complete substitute for mica (a new material seldom wholly replaces an old one) has some superior qualities that dictate its use even with mica readily available. It is much less affected by water than is mica and hence does not deteriorate in storage even under conditions of moisture. It does not delaminate. It has good arc-resisting qualities and excellent dielectric strength.

It has been used extensively as pole-cell insulation on a-c motors and is now being used regularly for commutator-bar spacers for small motors, Class B coil support channels, and for miscellaneous insulating structures that are difficult or impossible to fabricate from conventional materials.

HP CONDENSATE RETURN FOR HP SPACE HEATING

By J. P. Turner

Cochrane Corp., Philadelphia, Pa.

IN HIGH PRESSURE HEATING of commercial and industrial buildings, factories, foundries and warehouses, condensate from the blast heaters is usually returned to a vented receiver or open heater. With unit heaters operating at 100-psi this condensate leaves the heating coils at about 90-psi which corresponds to 331F. Assuming a typical heating load as 100 gpm (48,000 lb per hr), the loss of steam in flashing from 331F to 212F in an open hot well would amount to 6,240 lb per hr at the established rate of 13 per cent for this pressure differential. If steam can be generated at 32 cents a thousand pounds, which is a fairly economical cost, the loss of steam amounts of to $48.00 in a 24-hr day.

In addition the remaining condensate, 41,760 lb per hr, in dropping from 331F to 212F loses 121 Btu per lb (from steam tables). This heat loss totals 5,050,000 Btu per hr and is equal to the amount of heat contained in 4,250 lb of 100-psi steam. At 32 cents a thousand pounds the additional loss is $32.60 in a 24-hour day.

One method of recovering this heat is by returning the condensate at high temperature and high pressure directly to the boiler against boiler pressure as rapidly as it is formed. Ordinary feed pumps are not capable of handling the mixture of air and hot condensate. The condensate at close to vaporization temperature tends to flash and bind the pump.

In the Cochrane C-B high pressure condensate return system a specially designed centrifugal pump draws water from the thermo-fin priming loop and discharges it as a high velocity jet through the jet pump nozzle. This jet strikes the returned hot condensate and induces condensate flow through the Venturi-shaped mixing tube and into the thermo-fin priming loop. The additional volume of condensate introduced into the constantly filled loop results in the discharge of an equal volume through the air separator to the boiler.

The hot condensate and entrained air are drawn rapidly and positively from the heating coils by the jet pump. Air is eliminated from the circuit by passing through the air separator and the condensate is returned to the boiler at maximum temperature and pressure. Thus, the circuit from boiler, through equipment, and back to boiler is completed in a closed system without substantial drop in temperature. Performance of the unit is verified by the pressure gage on the inlet together with the pressure gage and thermometer on the outlet.

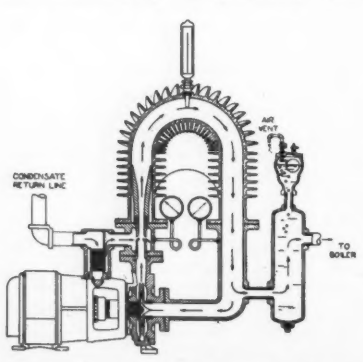


Fig. 2. Diagram showing flow of condensate through high pressure condensate return pump

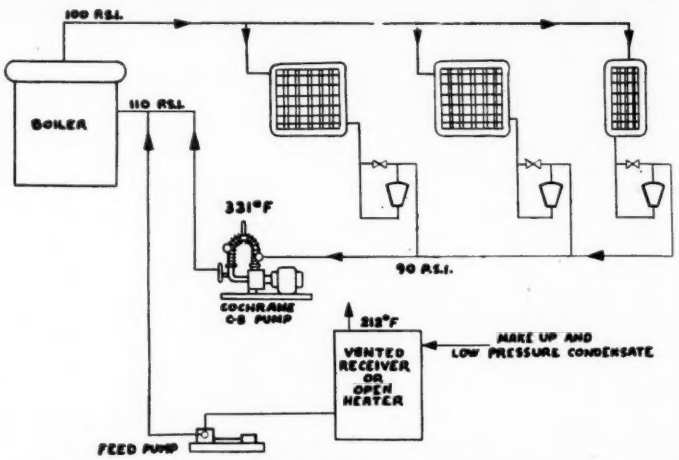


Fig. 1. Installation diagram of a typical Cochrane C-B high pressure condensate return system applied to space heating

The return system repays its cost several times over. In new systems, amount of radiation can be reduced due to the higher heat available from individual space heaters.

In a large foundry savings of $1635.-00 were made in an average winter month on a 240 gpm heating load at 75-psi. A similar record is being obtained in a 125-psi system extending over a number of widely separated individual buildings with excessively long return lines.

PRACTICAL HINTS AND KINKS

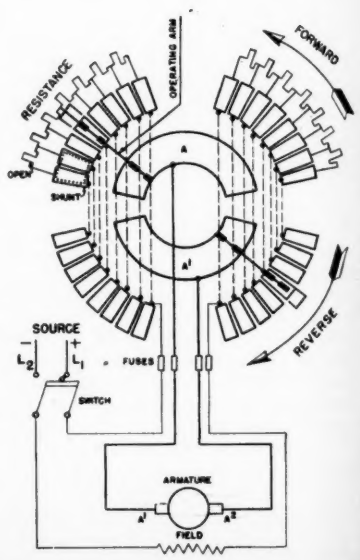
BIN FOR WORK BENCH

EMPTY SHOE polish tins make ideal small bins or open containers for small nails, screws and tacks, when nailed to the bench or to a shelf near the bench.

REPAIRING DIAL-TYPE CONTROLLER

By Paul C. Ziemke

HERE IS a suggestion on a speedy repair method for the one time popular dial type of controller. In the larger sizes these controllers have the resistor elements mounted in the cast iron base of the unit and while the perforated metal sides may be taken off to expose the resistor for repairs one usually finds that a break or "open" is located still farther back where the heat concentration is most severe. This means several hours of hard work for permanent repairs, especially if the controller is ganged up with others as in crane installations. This often means dismantling the wire trough or conduit run that ties them in to the contactor panel. Such major repairs being the



This sketch shows Mr. Ziemke's method of shunting out segments on dial-type controller

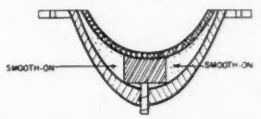
type usually postponed for the week end shut down any short cut emergency repair job is in order.

My method is that of shunting or bridging out the segments on the dial. The open section of resistor is easily located by the heavy arcing that occurs at the segments adjacent to the "open." The repair consists of taking off the segments from the slate dial plate and cutting a section of brass shim stock, or any similar light metal stock, to match the mark left on the slate. Four holes are then drilled or punched in the sheet to check with the mounting holes. Then the sheet stock is placed under the segments and the mounting screws are driven home. The slight increase in elevation of the two affected segments is not sufficient to cause any obstruction to the carbon brush of the current collector as it sweeps to and fro. As a rule the shortening of the resistor circuit by the method described is not readily noticeable in the operation of the motor yet it is recommended that permanent repairs be made as soon as convenient.

BEARING REPAIR

By S. Kulich

HERE's how we repaired the bearings on one of our machines with 51 cents worth of Smooth-On, a piece of ½-in. key stock and a bronze motor bearing of the proper diameter for the shaft. With a hack-saw we split the bronze bearing lengthwise and cut it and the



Sketch by Kulich showing how bronze bearing was installed by use of Smooth-On

key stock to the same length as the worn-out bearing. We cleaned out the old bearing case. Then we set a bronze bearing half and a key inside the worn-out bearing case, as shown in the sketch. Finally, we filled up the empty space with Smooth-On as shown. The repaired bearings work fine and have now been in use for 10 months.

LETTERS AND COMMENTS

TEMPORARY REPAIRS IN EMERGENCIES

DO TEMPORARY repairs pay in emergencies? Speaking from experience, I shall say they do, with few exceptions. For instance, a plant I was helping to keep going was threatened with a shut-down due to lack of sufficient water when a fluted pipe exploded after being weakened by rusting, thus putting a jet out of business. I found it impossible, with the tools I had, to form another flute on the pipe after cutting off the damaged portion. Rather than shut down the plant until a new pipe could arrive from a distant supply house, I fashioned a suitable flute by squaring the end of a pipe coupling, screwing it onto the end of a pipe, and cutting off a long enough piece to serve as a temporary flute. It performed satisfactorily until we had an opportunity to obtain new parts and install them for a lasting repair.

Sometime ago I was called upon to examine, and repair if possible, a thrust that was giving trouble on a machine in an industrial establishment. As described by the operator: "The adjusting screw that operates this thrust suddenly ran forward, throwing the pulleys out of line and tending to lock the machine. I ran it backward, the kickback spring responded, and I attempted to lock the screw in position with the lock lever; but it soon ran forward again in spite of my having made the lock lever quite tight."

I had the machine stopped, preparatory to determining the cause of the trouble. As the adjusting screw, emergency spring, and ball-bearing thrust were all situated in a bearing at the left-hand end of a shaft as I faced it, I first removed the bearing cap to get a full view of these parts. The thrust was hot and smoking a little in spite of its having been oiled liberally. Upon making a close examination, it was determined that the balls in the thrust (ball bearing) had worn until the ball bases met or ran together, locking and thus causing both ball bases and the balls all to turn as one unit in one direction without any intermovement. Since the motion of the shaft was transmitted from the thrust to the kickback spring, thence to the screw "washer," it was clear why the adjusting screw was turning forward in spite of attempts to lock it in position with the lock lever.

A simple remedy was applied as follows: Since the balls were still in good condition, it was only necessary to file away a part of the ball base faces—on the ball "race" side of the bases—to prevent their running together or meeting as formerly. (Be sure to file away enough to take care of the wear to which the balls have been subjected and then enough extra to provide some "spare" space between the ball bases to eliminate the necessity of having to repeat the repair job too often. Of course, there is a limit to the number of times a satisfactory repair can be thus made on any particular thrust.

Another method that works, in some cases, is simply to put in larger balls between the ball races, provided the balls are available in suitable numbers. Usually, a certain number of balls are required and this fact must not be overlooked in assembling a thrust. When larger balls are used, it may not be necessary to file away any of the ball race faces.

When the handle in an *only* scoop cracked at the first rivet in the ferrule, I took a 6 in. length of 1¼ in. pipe, drilled a rivet hole near each end, ripped the pipe open (into two pieces of equal size) at right angles to the direction of the rivet holes, and riveted the two halves snugly in position around the scoop handle. This emergency repair enabled us to have a scoop with which to do some necessary cleaning before the arrival of an important visitor at our plant.

J. R. KENNEDY

DE-INCHING WOULD FIX EVERYTHING

IT WAS A gloomy afternoon, I was slumped at my desk, a bottle of aspirin close at hand, worrying about increased costs, strikes, embargoes, and income taxes. I was getting nowhere and perhaps, unconsciously, was ripe for a diversion. So when the office boy brought in a card engraved D. R. EAMER, representing the *DE-INCH FOUNDATION*, I asked that the visitor be admitted.

I won't bother to describe his appearance, but he had a pair of 100-candlepower eyes and obviously no inferiority complex. He wasted no time on preliminaries, but delivered himself of the following:

"You are no doubt familiar with the wide-spread demand for inflation as a cure for our staggering debt and our present economic ills. We have had a taste of this in the reduction of the gold content of the dollar. But that was purely a bankers' scheme. The organization I represent proposes to confer

equal benefits on the rest of the public. We wish to solicit your approval for the re-valuation of the inch."

I gasped—and, for a moment, couldn't think of anything better to do than ask how inches tied up with prosperity. It didn't take long to find out.

"Everyone will benefit," he said, "as soon as we proclaim the new inch, which will be 90 per cent as long as the old inch. That by the way, is nothing sacred, being only a fraction of the length of some forgotten king's foot.

"The first beneficiary of our crusade will be the instrument manufacturer. Think of the sales volume when the country replaces its rulers, steel scales, tape measures, micrometers, and gages. Think of the stimulating effect on the users!

"Right now, I venture, you have in your desk some boxwood scales you have owned since college. Think of the lift you would get starting out with new tools.

"Now for the second group to be helped. You make pipe, you sell it at so much per foot, you are not making any profit! We cut down the length of the foot—you maintain the same price per foot—and presto!—your profits rise. Everyone making yard goods, wire, clothes-line, steel rails, fence posts, and perhaps macaroni will be equally benefited. It amounts to an absolutely painless price increase."

This sounded very attractive, but I was not going to be taken in and I asked about the farmer, as I had heard that he had a stake in the country's future. It did not bother Mr. Eamer a bit.

"He is going to be enormously assisted." he said. "The length of the inch of course determines the size of the acre. After our decree is proclaimed every farmer will have more acres than before, actually an increase of 23 per cent. Think of the improved morale when the sturdy agriculturist finds that his 160-acre farm has been transformed into nearly 200-acres."

Right here I got one of those flashes of genius which sometimes come to me. He was a plausible rascal, but by gosh!, he couldn't slip anything over me. I let him have both barrels.

"But he can't raise any more stuff, even if you do kid him about the size of his farm. I can't see any reason for him to be happy."

A slight look of annoyance came to my visitor's magnetic optics, but it wasn't for the reason I thought. Almost in a tone of pity he explained:

"You forget an important point. Farm products are measured in bushels, and the bushel is 2150 cu in. Modifying the lineal inch to 0.9, as we propose, will change the cubic measure as the third power of 0.9 with the result that our farmer will grow not only more bushels of product, but actually more bushels per acre. Again I point out the psychological lift.

"Now we come to the home front. You probably have often noted the pride with which a mother relates that Junior, only 9 years old, takes a size 12 sweater. All the sizes from shoes to intimate garments are based on inches. Thus at one stroke every 12-in. neck will require a 13½ collar and the lifted spirits of the populace will start a buying wave of unheard-of magnitude. Are you convinced?"

I was almost sold, but I had one more shot in the locker and I asked him, "How about central power stations? I've got some XYZ Power Co. stock. Are you going to do anything for them?"

"Definitely," he replied, "You are no doubt familiar with the increased thermodynamic efficiency due to high pressure. You will consequently realize that a steam plant now operating with 200 psi, will, with the new inch, automatically become a 246-psi plant with no capital outlay whatever."

"And we should not forget the oil company. The 231-cu in. gallon would be modified to the extent that their pipe lines, wells etc. would deliver roughly 37 per cent greater output and I don't want to hear you object that it will cost you more to drive your car. The facts of the matter are that the new inch will give you greater speed. Wouldn't you feel proud to have the six year old bus speeded up 10 per cent with absolutely no difference in safety or wear?"

That was enough. I signed on the dotted line and gave him a check, but since he left I have been thinking it over and I sure hope that my wife remains in ignorance of my support. She is not going to like it when the *DE-INCHERS* turn her perfect 36 into a 40.

ELMER S. SMAIL

Oak Park, Ill.

WORK SCHEDULES

UPON READING some of the work schedules submitted by various POWER PLANT ENGINEERING readers, I thought I would submit this one, with hopes that it may be of some benefit for those who may have a condition similar to this one.

But first let me set down a few prerequisites, before I explain the function of this work schedule.

(a) To be used mostly where a continuous operation prevails, meaning of course a twenty-four hour day—seven day week—all year 'round.

(b) To eliminate off days in the middle of the week, that are very discouraging to many workers, who must work Saturday or Sunday or both while having to take off any day from Monday to Friday.

The outstanding benefit of this schedule lies in the number of hours, bonuses, etc. that each shift receives, without the loss of time or money to its employer, and it also provides a full week off for every shift once every fourth week.

The procedure of this work schedule follows:

Assume, A-B-C-D represents four different shifts. The first week (A—7-3) (B—3-11). (C—11-7) (D—off) (D—returns the second week 7-3) (A—3-11) (B—11-7) (C—off) (C—returns the third week 7-3) (D—3-11) (A—11-7) (B—off) (B—returns the fourth week 7-3) (C—3-11) (D—11-7) A—off). Then a repetition of the same thing.

A. F. CUTTITTA

WHAT'S AN ENGINEER?

I HAVE read the article "What's an Engineer?" by J. B. Linker and I don't believe there will be much comment about it; the average practical engineer isn't interested in expressing his views on this subject.

To begin with I would like to add a

Work schedule for 7-day week, 24-hour day which will give one shift a week off every 4 weeks

	1ST WEEK							2ND WEEK							3RD WEEK							4TH WEEK						
	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S
A	7-3 8	7-3 8	7-3 8	7-3 8	7-3 8	7-3 8	7-3 8																					
B	3-11 8	3-11 8	3-11 8	3-11 8	3-11 8	3-11 8	3-11 8																					
C	11-7 8	11-7 8	11-7 8	11-7 8	11-7 8	11-7 8	11-7 8																					
D	OFF	OFF	OFF	OFF	OFF	OFF	OFF	D	7-3 8	7-3 8	7-3 8	7-3 8	7-3 8	7-3 8	7-3 8														
								A	3-11 8	3-11 8	3-11 8	3-11 8	3-11 8	3-11 8	3-11 8														
								B	11-7 8	11-7 8	11-7 8	11-7 8	11-7 8	11-7 8	11-7 8														
								C	OFF	OFF	OFF	OFF	OFF	OFF	OFF	C	7-3 8	7-3 8	7-3 8	7-3 8	7-3 8	7-3 8	7-3 8							
																D	3-11 8	3-11 8	3-11 8	3-11 8	3-11 8	3-11 8	3-11 8							
																A	11-7 8	11-7 8	11-7 8	11-7 8	11-7 8	11-7 8	11-7 8							
																B	OFF	OFF	OFF	OFF	OFF	OFF	OFF	B	7-3 8	7-3 8	7-3 8	7-3 8	7-3 8	7-3 8	7-3 8
																								C	3-11 8	3-11 8	3-11 8	3-11 8	3-11 8	3-11 8	3-11 8
																								D	11-7 8	11-7 8	11-7 8	11-7 8	11-7 8	11-7 8	11-7 8
																								A	OFF	OFF	OFF	OFF	OFF	OFF	OFF

few words about the men in our profession . . . the ones that are around today and the fellows coming into this trade. I believe that I can say something authoritative on the practical side of engineering as I've put all my time into this trade since I was a young man. I have the highest respect for the engineers who tried to help me out many years ago; they showed me that practical knowledge without book learning meant I would be just another operator.

About we fellows who are called practical engineers: There are many of us who carry an engineer's license who wouldn't make a pimple on a fireman's face. This type of engineer is less inclined to try to get more knowledge after receiving his license because he probably figures he doesn't need anything else. This is the type of engineer, who if a question is put to him, blows up because he thinks the person asking is trying to "stick" him. When he doesn't know he isn't honest enough to admit it.

Then there is the practical engineer who will not only go to night school but will have taken a course or two in engineering by correspondence. Also, some of them have taken some business course to assist them to higher positions. Besides this they probably belong to some engineering society or association and give freely to their time and talents. These are the practical men who are a credit to the trade.

I would like to ask this question at this time: Are we stationary engineers, powerhouse engineers, operating engineers or watch engineers? As to the professional engineer, I am not one of those and so cannot say much about them. But I do know that those engineers who go to school will get the foundation that the average practical man never gets. He gets the "know how" much more easily than the engineer who comes up the hard way. I know of the feeling between the professional and the practical man, but let's just imagine for example, two men starting out as operating men in the boiler room as helpers. I believe that the man with the education has no desire to continue doing manual labor, if he has any ambition at all. The fellow with only a grade school education, however, if he does try to get ahead has a much harder time. I know several professional engineers and they are good men and willing to help any operating man to obtain more knowledge of his equipment.

What I'm interested in is seeing that the practical man will do all in his power to get all the information and knowledge that's possible. Look around, J.B.L., and see the operators, watch engineers or whatever you care to call them and see if they take correspondence courses or night courses in some local school. Or if they even read the bulletins put out free by most concerns on boilers, pumps, feedwater heaters, packing, refrigerating equipment, valves or water conditioning.

So instead of trying to get distinction from a mere title, let's get the knowledge across to the company that with the proper equipment money can be saved. Let's not give to someone the authority to do the buying and ordering of repairs when he doesn't know a Btu from a packing gland.

It seems to me that the professional is the better salesman than the practical man because the small plants are gradually fading out of the picture. If the practical man can convince the front office that he can save them money with the equipment he is now operating, then there will be a chance to remain what we like our friends and neighbors to know us as, and that is ENGINEERS.

T. F. CUNNINGHAM

Questions And Answers

Question No. 376

WHAT TESTS AND PROCEDURE WILL IMPROVE PRECIPITATOR OPERATION?

IN OPERATING a precipitator used in conditioning the water for our plant, we are having trouble in getting the optimum floc for various grades of water.

The source of the water is the Delaware River. Each turn of the tide creates a problem, as the waste from factories above and below us on the river sweeps past our intake.

We are now using the jar test on the raw water to determine the amount of alum, soda and clay to be used in the precipitator. To date this has proved inadequate.

I would like to get a detailed explanation of the jar test and any other tests and operating hints that will help us cope with this situation.

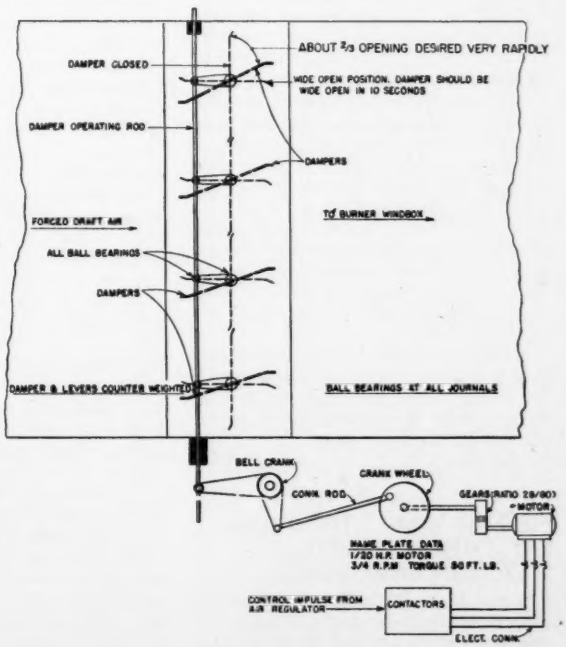
Philadelphia, Pa. R.T.F.

Question No. 377

HOW MAKE FORCED DRAFT AIR FOLLOW FUEL FEED?

ON EACH of our two boilers, dampers in the forced draft air duct ahead of the combination pulverized coal and oil burners are installed as shown in the accompanying sketch. For reasons given below, we want those dampers, starting from closed position, to "snap" open about two-thirds of the way as quickly as possible, as fuel feed is increased from minimum to maximum in 10-12 seconds. But the motor, driving the dampers through gears, operates at constant speed, hence the dampers open at fairly constant speed. As a result, the forced draft air flow does not follow the fuel feed as closely as we want it to and we make some smoke and there is danger of loss of ignition.

Now, what I want to know is this: Without remodeling our combustion control system, is there any kind of a



Sketch by E. E. showing how his forced draft burner windbox dampers are operated by a motor actuated from the combustion control and how he wants them to operate

mechanical linkage or leverage or device that we can install there between the gear and the damper operating lever, to jerk that damper about two-thirds open or closed and then allow it to take a slower speed for the rest of the stroke?

Here's the reason we want the damper to operate in this way. We have two boilers of 40,000 lb per hr capacity each; one of these is operated at a time to supply steam to several steam turbine-driven blowers in processes. These blowers must be turned on to pick up the load from zero to full load in a matter of 10 or 12 seconds, thus requiring the boiler to pick up load from about 4000 or 5000 lb per hr (or whatever is the minimum load at which burner ignition can be maintained) to approximately 40,000 lb per hr in 10 or 12 seconds. The boilers normally are fired with fuel oil, with pulverized coal as alternate fuel. They are equipped with an electrical automatic combustion control system. The forced draft fan is driven at constant speed and has ample capacity.

Massachusetts E.E.

Question No. 378

WHY DO DUPLEX PUMPS SLAM WHEN FEEDWATER TEMPERATURE DROPS?

WHY DO OUR feed pumps slam when the feedwater temperature drops suddenly 20 or 25 degrees? Here's what happens.

We have two steam-driven duplex boiler feed pumps, each 8 by 5 by 10 in., feeding two 250-hp Stirling boilers. Steam pressure is 225 psi. Boilers are operating at about 150 to 180 per cent of rating.

The open feedwater heater is placed 14 ft above the pumps, which take suction from it. The heater is supplied with steam from the exhaust of a steam-driven air compressor.

When the compressor is working hard, the temperature of the feedwater is 225 to 230 F. When the load is taken off the compressor, the water temperature drops 20 to 25 degrees and the pump that is operating starts acting as though it had a vapor lock.

I have my own ideas about what happens but would like to know what other engineers think.

I am confident there is no valve trouble as the trouble occurs when the valves are newly ground and seated. The way the valves are built, I don't believe they can contract and seize the valve spindle.

Sometimes a pump will pull itself out of this trouble before we can get to it. But other times we have to shut it down before it relieves itself. Both pumps act the same way.

Seattle, Wash. J.R.H.

Answer No. 334

FIRST HE WANTS THE STEAM DRY, THEN HE WANTS IT WET FROM SAME BOILER

IN THE MAY, 1946 issue, J.E.Y. asked what could be done in his cleaning and dyeing plant to get wet steam for his wool and silk presses, so they would do a better job. His boiler steam was dry he said, and gave good results in his drying tumblers, hot head presses and dry rooms. Could he get both the wet and the dry steam from the same boiler?

Many good and practical solutions to this problem have been suggested and the discussion has run on for months. But all through this discussion, we had a feeling that not all the answerers were perfectly clear as to the various kinds of presses J.E.Y. was talking about. Perhaps we should have thought of this at first but we assumed everybody in this field would understand that. However, it is clear that many did not.

Our old friend, Chas. W. Parks, has also perceived that there has been some confusion about the presses referred to. He clears it up very well in the comment below, which we think brings this interesting discussion to a well-rounded conclusion for the benefit of the many engineers who have to do with such presses in hotels, hospitals, institutions, laundries, and the like.

Parks Clears Up Some Confusion About the Presses

IN THE MAY 1946 issue, J.E.Y. requested aid of PPE readers to solve his problem of how to get wetter steam for presses from the same boiler that also supplies dry steam for other purposes. Many good answers were submitted. In the January issue, one reader brings up the question of why J.E.Y. even needs wet steam at all. There seems to be a slight confusion about these presses. For the benefit of everyone concerned, I will endeavor to define the difference between various presses.

In the original question, mention was made that J.E.Y. operates a large dry-cleaning plant. But his own statement leads me to believe that he has a combination laundry and dry-cleaning plant. Now there is just as much difference between a laundry and a dry-cleaning plant as there is between day and night and just as much difference between a dry-cleaners press and a laundry press.

In the first place, a dry-cleaner's press is used for nothing but wools and silks, while a laundry press is used for pressing or ironing cotton goods.

A dry cleaner's press "steams" out a wrinkle or "steams" in a crease, while a laundry press irons out the wrinkles the same as you would do with a hand iron, only many times faster.

The dry-cleaning press depends on the moisture of the steam for its function, while the laundry press depends on the direct heat transfer from the steam and the pressure of the head.

Let us take each machine separately.

The Dry-Cleaners Press—The dry-cleaner's press or, "tailor's press," as it is sometimes called, has a steam valve mounted on top of the head and operated by a hand lever. The head and buck has a series of small holes drilled throughout its entire length. Under the press is a vacuum valve. This valve is really a three-way valve and is fitted with two levers or treadles.

In operation, a garment is laid out on the buck and the head brought down hard on the material and held there or locked. The operator then pulls the lever, allowing live steam to issue from the small holes and into the garment. At the same time, he presses on the floor treadle and live steam issues from the holes in the buck and into the garment.

After a few seconds, he releases both steam valves and steps on another treadle which throws the valve to the vacuum side. This allows live steam to blow to the atmosphere. This creates a partial vacuum in the buck and draws out all the excess steam and moisture, leaving the garment dry. The treadle is then released, the head is released and the garment rearranged for the next pressing position.

When the vacuum valve draws out the moisture and blows it to the atmosphere, this produces the familiar puffs of steam that are seen blowing from the corner tailor shop.

The Laundry Press—The laundry press may be known by the work it is designed to do, such as a "wearing apparel press," a "shirt press," a "collar-and-cuff press" or simply a "hot head," which includes all of them The heads of these presses are built of steel or aluminum to stand a pressure of 125 psi and are machined and polished to a high finish. The bucks are covered with heavy padding and duck and both are curved to fit into one another. Steam is piped, by means of flexible tubes or swivel joints, to the head and buck of the press, thereby keeping them hot.

Steam enters one end and leaves the other through a trap.

A piece of material is laid carefully out on the buck and the head brought down hard on the material and left there a few seconds (usually while the operator is changing material on the other press).

All modern laundry presses are pneumatically powered. Compressed air at about 90 psi is piped to the press cylinders. By depressing two handles on the table, the operator is able to bring the press down hard with little or no effort on her part. The great pressure and the heat of the steam presses or "irons" out the wrinkle in the goods. The old-type presses were all hand operated. The heads were counter weighted to make them movable. The modern press is pulled back to the open position by heavy springs after the air is released.

From the above description, it is not hard to see why J.E.Y. wanted wet and dry steam from the same boiler. With dry-cleaning presses, if the steam is too hot or dry, little or no moisture is in it to dampen the material. On the other hand, if the steam is too wet with a laundry press, there is not enough heat to properly dry the clothes and it takes much longer, and,

as most of these operators work on piece work, plenty of "squawks" come the engineer's way if he can't keep the pressure up.

While we are on this discussion of laundries, we may as well say that no flat work is ironed or pressed on presses but is run through a large machine known as a flatwork ironer or "mangle," as they were formerly known. These machines consist of a series of steam chests (stationary) with a set of rolls turning slowly in them. The chests are curved to fit the rolls and highly polished. The rolls are heavily padded and are about 11 in. to 12 in. in diameter with the padding on. They are turned by spur gears attached to each end. Steam enters the chest at one end and leaves the other end by way of a trap.

Baltimore, Md. CHAS. W. PARKS

Answer No. 342

HOW FAST DOES A WIRE OR ROD CONDUCT HEAT?

Dr. Giomi Disagrees With R.C.L.

IN THE December issue, in the answer that R.C.L. gives to this question, I think that this solution is incorrect because the formulas R.C.L. applies are not usable in this case.

In effect, he uses Fourier's Law in the form: Rate $= \frac{hA\Delta t}{L}$. This formula is only an application of the general Fourier's Law: Rate $= -hA\frac{dt}{dL}$ where $-\frac{dt}{dL}$ is the temperature difference that we would have between two surfaces at the unitary distance. The formula that R.C.L. applies is deduced from the general one considering a wall in "steady state," i.e. where the same quantity of heat passes through each section of the wall. This is not the case here, because, if we consider the rod divided in small portions, it is evident that part of the heat that enters one of those portions is spent to increase its temperature, so the quantity of heat that enters the following portion is smaller.

From the foregoing, we see that the temperature differential is not constant, but decreases with the increase of L. For this reason also, the assumption that the temperature gradient follows a linear law during the two steps into which he divides the solution of the problem is not correct. Of course, if the premises are not correct, the conclusions can not be true.

Even if the premises were correct, I think that the solution is not correct because the integrals at which R.C.L. arrives are not integrals. The first

$$\int_{L=0}^{L=20} \frac{dH}{dR} = \frac{5960\ A\ dL\ L^2}{51100\ A\ dL} = \frac{L^2}{8.57}$$

can not be integrated because it does not contain differentials, although its value depends on L. No matter what the initial and final temperature of the rod, with this integral we arrive at the same value for the hours necessary for the heat to reach the farthest end of the rod.

The second integral is worse, because not only does it omit the differential dt, but its value depends exclusively on L and not on t, the variable within whose limits it would be integrated. So this integral leads to the absurd conclusion that whatever the temperature difference of the two ends of the rod, the time to reach a uniform temperature would always be 46.6 hr.

Milan, Italy M. GIOMI

Answer No. 357

HE WANTS FLEXIBLE SHAFT TO TRANSFER RECIPROCATING MOTION

Sheffer Suggests a Crank Arrangement

THIS WRITER knows of no flexible shaft especially designed to transmit motion in a push-pull effect.

It might be well for J.E.P. to consider a conventional flexible shaft with a crank attachment, to operate his loom improvement.

The motion of the crank could be applied by a regular connecting rod, a Scotch yoke, a cam slot or other suitable arrangement.

Wingdale, N.Y. WILLIAM SHEFFER

Answer No. 358

HOW MUCH CHLORINE FOR SWIMMING POOL WATER?

Sheffer Says Copper Sulfate Will Do It

REFERRING to G.B.'s swimming pool dilemma, copper sulfate will dispose of the algae. Before using the chemical, however, the pool should be cleaned thoroughly.

While there are some families of algae commonly found, and the vitriol concentration necessary to destroy one of the most tenacious of life, (*Zygenma*, an algae of the filamentous type) is quite high (4 to 5 lb per million gallons), an effective starting dose would be 2½ lb of copper sulfate per million gallons of water.

The chemical may readily be applied by dragging a burlap sack, containing the required dose, through the water by any suitable means. If the algae persists, doses up to 4 or 5 lb per million gallons may be used.

The destruction of the algae will probably produce unpleasant odors, but those won't last long.

In regard to the chlorine, it is taken for granted that G.B. has a colorimetric test kit, or has access to one.

Chlorine should be fed so as to maintain a residual of 0.2 ppm some ten minutes after contact with the water. Inasmuch as G.B.'s problem has nothing to do with water for drinking purposes, he could safely raise the feed so as to maintain a residual of 0.5 ppm with no objectionable results. Such a residual will act as a deterrent to future algae growths.

The exact amount of chlorine necessary can only be determined by experiment, as water will vary from place to place and, in G.B.'s case, from time to time, depending upon the number of swimmers using the pool, the number and kind of organisms entering with the make-up water, and other factors.

It is strongly recommended that G.B. install a bank of showers for the use of the swimmers before entering the pool. For strictly sanitary reasons, use of the showers should be made compulsory.

Wingdale, N.Y. WILLIAM SHEFFER

Comments from Graber

WE HAVE a triple plunger type pump. On the one plunger we use chlorine; on the second plunger, alum; and on the third soda-ash. Now the chlorine, alum and soda ash pump motor is connected to a switch, which is in turn connected to our main circulation pump switch.

When the pool is in operation all the pumps work together. When the pool is shut down all the pumps are stopped.

It does not matter how many pounds of chlorine you put into the pool as long as you keep chlorine reading between 0.2 and 0.5 ppm and a pH reading between 7.2—7.6, and a turnover of your pool water from two to three times per day. The coagulant added to the water reacts with the alkalinity present to form floc which is a jelly-like substance. The floc is separated from the water by the sand filters, which gives you clean and sparkling water for your pool.

Norristown, Pa. ANDREW G. GRABER

Comments from Clyde Davis

HAVING HAD quite a bit of experience with pools in our school plants, I will try to answer some of G.B.'s questions. The main one was, how much chlorine to use. This amount is best found by using a comparator. These are obtainable from Wallace & Tiernan Products, Inc., Belleville, N.J. or W. A. Taylor & Co., 7301 York Road, Baltimore 4, Md.

Other factors enter into keeping of bacteria down in a swimming pool. They are: cleanliness of bathers, filtering water and constant watchfulness. With a heavy load of bathers, the chlorine will drop to an unsafe level very quickly. The proper operation of the filter depends on the proper use of alum and soda ash.

There is a small pamphlet giving good information, called "Keep Your Pool Clean and Sparkling" published by Western Filter Co., Box 6884 Stock Yards Station, Denver 16, Colo. Taylor swimming pool water control equipment booklet has a very good article, well worth reading.

Tacoma, Washington CLYDE DAVIS

Comments from Dingfelder

IN THE FIRST place, G.B., do you have a way of testing the pool water for residual chlorine and a way of determining whether the water is acid or alkaline? I believe it would be pretty difficult to operate a pool effectively without some way of testing the water.

Do you have alum and soda ash pots? If so, are you using the proper amount of both? The pool water should test alkaline or else the alum will not coag-

ulate and form a "floc" on the top of the filter bed. If too much alum is used, some will find its way back to the pool and settle on the bottom, causing a mossy appearance.

Are the filter beds in good condition? They may be channeled and a new bed needed. Do you backwash often enough? Do not use too much pressure when backwashing, not over 20 lb, for too much pressure will channel the filter beds. After backwashing, run water to sewer for a while before filtering to pool. Backwashing causes the "floc" to be washed from the top of the filter bed, so after backwashing, be sure and add fresh alum, first making sure water is alkaline. Alum and soda ash should do the trick—can be put directly into the pool over the drain. Experience will tell you when the proper results are obtained. The water in your locality will also affect the amount.

You ask how often the chlorinator must pump. This all depends on how many persons use the pool. If a small number use it, less will be required. Testing the water will tell you. Take a test 3 times a day, taking a sample from the shallow end, the center and the deep end, to get an average reading. If the test is taken near the inlet, the reading will be higher, as the chlorine has not had time to mix with the large mass of water in the pool.

The residual chlorine reading should be between 0.2 and 0.5 ppm (parts per million) and the alkalinity between 7 (which is neutral) and 7.6. If below 7 the water is acid.

If I can help further, write to me. Woodside, N.Y. EARL A. DINGFELDER

Answer No. 360

CAN HE GET MORE POWER BY BALANCING UP 3-PHASE LIGHTING CIRCUITS?

How Hvidston Would Do It

E.M.D. does not state what the limiting factor is in his present setup, i.e., prime mover overload, generator heating, etc.

Unbalanced load on a 3-phase generator will cause heating. The generator is not overloaded as long as the temperature rise does not exceed nameplate rating.

Paralleling secondaries of transformers with primaries on different phases is out of the question, for reasons given by E.M.D.

I have had much success using a 3-phase multi-breaker load center supplied from a 3-phase transformer bank, as shown in Fig. 1. By placing a transformer bank at each load center, long secondary runs are eliminated. I have found that changing existing lighting panels over to 3 phase is worth the trouble of pulling in one extra wire.

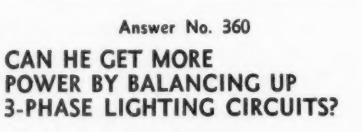


Fig. 1. Diagram by Hvidston showing how he recommends connecting transformers

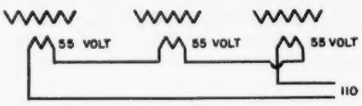


Fig. 2. Hvidston says this would give 1-phase load from 3-phase system but with low power factor and poor regulation

Since E.M.D.'s load is mainly motors, the answer to his problem may be power factor improvement. The connection in Fig. 2 will give single-phase load from a 3-phase system without unbalance but transformer capacity must be 50 per cent greater than load and voltage will be twice the voltage of single transformers.

This would require 55-v transformers. In addition, power factor on two phases would be low and regulation bad.

St. Joseph, Michigan DEAN HVIDSTON

Answer No. 363

WHAT SHOULD HE DO ABOUT THIS EXCESS EXHAUST STEAM?

Andrews Calculates Advantages of More Motor Drives to Improve Steam-Electric Balance

IN THE NORMAL operation of a refinery it is not unusual to have large quantities of exhaust steam discharging to the atmosphere. C.G.M. states that some of this is being used for heating boiler feedwater, heating oil in storage, heating buildings and for process operations. These uses are all proper and desirable. Assuming that exhaust steam has been used to the maximum practical extent for heating and process purposes, and that exhaust steam has been substituted for superheated plant steam wherever possible, there remains much that can be done to reduce the atmospheric loss.

Evidently a fundamental unbalance exists between the utilization of steam and electric-power-driven equipment in this plant. In general, the generation of by-product electric power through the use of high-pressure boilers and non-condensing turbines will not materially alter this situation. Although profitable in themselves, high-pressure boilers and topping turbines merely substitute generated power for purchased power. The excess exhaust steam will remain, unless reduced by other means.

In all probability, the best means of restoring the power balance will be to substitute electric motors for steam turbines, either in the boiler house or in water pump houses, air or gas compressor installations, or refinery process units, depending upon the reliability of electric power supply and distribution and the size and efficiency of the individual power units. The range of application can be determined simply by constructing a chart, like the one given herewith, which shows

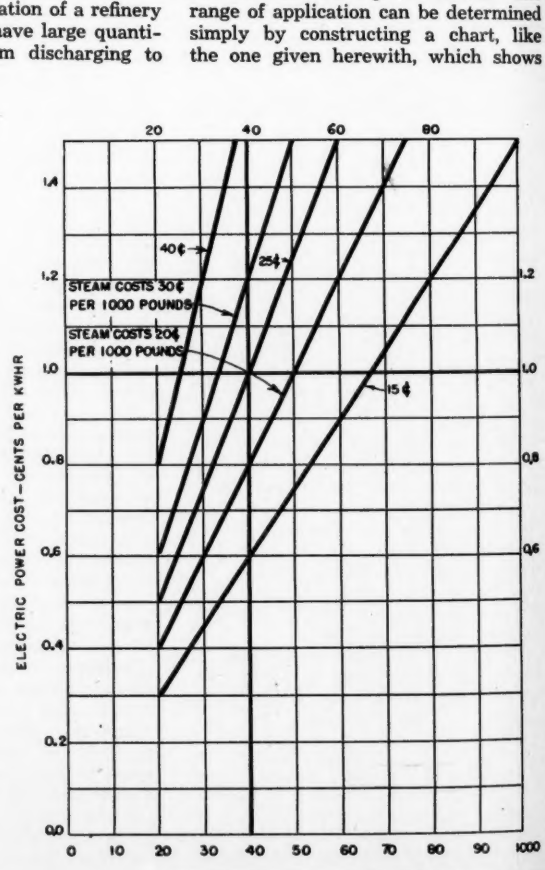


Chart by Glenn N. Andrews showing turbine water rates plotted against electrict power cost, for comparing costs of steam and motor drives

electric power cost in cents per kwhr as ordinates versus turbine water rates in pounds of steam per brake horsepower. A group of straight lines, representing steam production cost in cents per thousand pounds, is shown slanting upwards from the point of origin.

The simple approximation 1 kva = 1 hp holds true for most typical combinations of power factor and motor efficiency between 0.8 and 0.9, since one horsepower = 0.746 kw. For instance:

Average motor efficiency	= 0.829	0.877	0.932
Average power factor	= 0.9	0.85	0.8
and their product	= 0.746	0.746	0.746

Assuming the purchased power rate per kwhr is based upon kva at unity power factor, with a sliding scale penalty for progressively lower power factors, the approximation 1 kw = 1 hp also holds true.

Two basic problems can be illustrated by the following figures:

Assume:	
Total steam demand	200,000 lb/hr
Process and heating load = 50%	100,000 lb/hr
Power load = 50%	100,000 lb/hr
Feedwater demand (16 2/3% blowdown)	240,000 lb/hr
Feedwater net heat (80 F to 230 F)	150 Btu/lb
Plant steam net heat (superheat 200 F)	1100 Btu/lb
Exhaust steam net heat	1000 Btu/lb
Purchased power cost	1.0c/kwhr
Steam production cost	40.0c/1000 lb
Exhaust steam value	nil
Live steam pressure	150 psig
Exhaust steam pressure	10 psig
Fractionation pressure	30 psig
Turbine water rate at 10 psi exhaust	40 lb/bhp
Turbine water rate at 30 psi exhaust	50 lb/bhp

The calculations involved in determining the substitution of electric motors for steam turbines are as follows:

Exhaust steam production equals power load	= 100,000 lb/hr
Exhaust steam required to heat feedwater (240,000 × 150) ÷ 1000 =	36,000 lb/hr
Exhaust steam to atmosphere (by difference)	= 64,000 lb/hr
Cost of operating steam turbines which are economically replaceable by electric motors: 64,000 lb hr at 40c/1000 lb	$25.60/hr
Cost of operating equivalent motor drives 64,000/40 = 1600 hp at 1.0c	16.00/hr
Potential saving	$ 9.60/hr

With reference to the 2500 lb per hr of steam required at 30 psi for fractionating purposes, the cost of obtaining this by thermal compression would be approximately 2500 × (1.75 ÷ 1 + 1.75) = 1600 lb/hr at 40c = $0.64/hr.

A less expensive means of providing this fractionating process steam would be to convert an existing 50 hp steam turbine to operate at the higher back pressure. This could be done in most cases by adding jets and overload valves and replacing governor parts if necessary. The cost of 2500 lb per hr of exhaust steam at 30 psi would then be as follows:

50 hp × (50 water rate − 40 water rate) = 500 lb/hr net additional plant steam at 40c/1000 lb = 20c/hr.

The saving in this case would be 64c minus 20c or 44c/hr.

Thus the 30 psi exhaust from a steam turbine would cost roughly 30 per cent as much as that produced from a thermocompressor. Replacement of the turbine with a motor would not be practical because steam is needed for the process in any case.

For the illustrations given above, the turbine water rates assumed are typical of efficient high speed operation—4000 to 5000 rpm. Reducing gears would be employed for driving fans and pumps. Turbines operated at low speeds are much less efficient, often using 100 lb of steam per hour per brake horsepower or even greater amounts. These figures are also typical of many slide valve direct acting reciprocating steam pumps.

By reference to the chart, the profitability of replacing individual steam drives with electric motors may be determined quickly. For the specified cost of purchased electric power (1.0c/kwhr), or lower rates, very few combinations of steam production cost, water rate and horsepower fail to show substantial profitability for the replacement of turbines with motors, as long as sufficient exhaust steam remains in excess, available for feedwater heating and process needs.

Roxana, Illinois — GLENN N. ANDREWS

Answer No. 364

DOES HE NEED TO GET RID OF THE BOTTLENECK?

Eliminating the Bottleneck Won't Help, Says Wenig

INCREASING the size of the so-called "bottleneck" will have no effect upon the volume of steam going into the radiators.

The two factors which control the volume of steam (assuming the lines are clear and the traps are in good working order) are the pressure and the size of the steam line from the reducing valve to the radiators. If you would like to increase the volume of steam and keep the pressure at 15 psi the only thing you can do is increase the size of the 15-lb steam line.

However, in view of the fact that the radiators are giving enough heat, it would be a waste of time, money and energy to make any changes to your heating system.

Brooklyn, N.Y. — ARTHUR J. WENIG

Answer No. 361

WILL IT PAY TO USE EXHAUST STEAM IN THIS HEATING SYSTEM?

Slavinsky Says It Will

IT IS GOOD engineering practice to utilize the work performed by the exhaust steam rather than waste it and use live steam for heating. The plant W.E.C. is operating appears to be a non-condensing plant, so I would suggest that he use all of his exhaust steam for heating and arrange the layout so as to introduce the live steam to heating as the requirements justify it.

W.E.C. must bear one thing in mind: that is, to install a safety valve or relief valve on the exhaust line so that if his pressure builds up, due to a sticky reducing valve, his equipment will be amply protected against too high a back pressure.

The plant I operate is utilizing all of the exhaust steam for heating and processing. The difference in pressure loss is made up by the introduction of live steam through a reducing valve.

The exhaust lines are protected with safety valves set to pop at a pressure not to exceed 15 psi. We exhaust against a 15-psi back pressure in our system. Part of the exhaust steam is used in the feedwater heater. We also have an atmospheric relief valve located above the heater on the exhaust line.

Yes, by all means use up the exhaust steam first and then add the live steam as and when needed.

Ridgefield, N.J. — JOHN F. SLAVINSKY

Answer No. 365

WHAT SHOULD BE DONE ABOUT THIS OLD PLANT?

Economizer and Condensate Return Should Improve It, Says Kulich

C.H.T. feels that something should be done about this plant. However, the plant was installed in 1921 and is not too old yet. It is equipped with 7 boilers with high capacity, using 200-F feedwater. I suggest that C.H.T. install a good-sized economizer to take care of the gases from the uptake from the 7 boilers. This will increase the feedwater temperature to 300 F and should cut the coal consumption over 25 per cent. C.H.T. does not mention where the condensate is lost. Why can't this be recovered and run into some storage tank or accumulator and pumped back to the boilers?

Brooklyn, N.Y. — S. KULICH

Answer No. 366

WOULD ENCLOSURE IMPROVE OIL COOLER?

Yes, With Slight Changes, Says Kulich

THE OIL COOLING system of S.S. shown in his sketch would be sufficient, provided slight changes are made to improve the air circulation. (1) Provide an outlet at the top of the radiator to allow the hot air to escape. (2) Circulate the oil from the tank to the radiator; that will require a thermostatically controlled circulating pump to force the cooled oil out from the radiator to replace the hot oil.

Brooklyn, N.Y. — S. KULICH

Answer No. 367

WHY DOESN'T HIS CHIMNEY PRODUCE ENOUGH DRAFT?

Use a Thick Brick Lining to Reduce Diameter, Says Kulich

ACCORDING to L.H.'s explanation, the chimney is 38 in. too large in diameter. Therefore, I suggest installing approximately 18 in. of brick lining in the chimney. That will reduce the diameter to 48 in. Also if it is convenient, increase the ash-pit doors to approximately 48 in. wide on each boiler. That will overcome the difficulty with sawdust and wood burning.

Brooklyn, N.Y. — S. KULICH

CHIMNEY CALCULATIONS

TABLE OF SIZES FOR NATURAL-DRAFT CHIMNEYS

Based on: 62° F. atmospheric temperature, 500° F. chimney gas temperature, 0.09 chimney gas density, 0.016 coefficient of friction, sea level elevation.

Amount of gases flowing, lb. per sec.	Required draft at breeching entrance, in. water												
	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6
	Economical size of chimney height and diameter, ft.												
5	75 3.5	95 3.5	115 3.5	135 3.5		.....	.....	.....	.....	.....	.....	.....	.....
10	75 4.0	95 4.0	115 4.0	135 4.0	150 4.0	.....	.....	.....	.....	.....	.....	.....	.....
15	75 4.5	95 4.5	115 4.5	135 4.5	150 4.5	170 4.5	190 4.5	.....	.....	.....	.....	.....	.....
20	75 5.0	95 5.0	115 5.0	135 5.0	150 5.0	170 5.0	190 5.0	.....	.....	.....	.....	.....	.....
25	75 5.5	95 5.5	115 5.5	135 5.5	150 5.5	170 5.5	190 5.5	.....	.....	.....	.....	.....	.....
30	....	95 5.5	115 5.5	135 5.5	150 5.5	170 5.5	190 5.5	.....	.....	.....	.....	.....	.....
35	....	95 6.0	115 6.0	135 6.0	150 6.0	170 6.0	190 6.0	210 6.0	.....	.....	.....	.....	.....
40	....	95 6.5	115 6.5	135 6.5	150 6.5	170 6.5	190 6.5	210 6.5	.....	.....	.....	.....	.....
45	....	95 6.5	115 6.5	135 6.5	150 6.5	170 6.5	190 6.5	210 6.5	.....	.....	.....	.....	.....
50	....	.....	115 7.0	135 7.0	150 7.0	170 7.0	190 7.0	210 7.0	230 7.0	.....	.....	.....	.....
60	....	.....	115 7.5	135 7.5	150 7.5	170 7.5	190 7.5	210 7.5	230 7.5	.....	.....	.....	.....
70	....	.....	.....	.....	150 8.0	170 8.0	190 8.0	210 8.0	230 8.0	250 8.0	270 8.0	290 8.0	310 8.0
80	....	.....	.....	.....	150 8.5	170 8.5	190 8.5	210 8.5	230 8.5	250 8.5	270 8.5	290 8.5	310 8.5
90	....	.....	.....	.....	.....	170 9.0	190 9.0	210 9.0	230 9.0	250 9.0	270 9.0	290 9.0	310 9.0
100	....	.....	.....	.....	.....	170 9.5	190 9.5	210 9.5	230 9.5	250 9.5	270 9.5	290 9.5	310 9.5
110	....	.....	.....	.....	.....	170 9.5	190 9.5	210 9.5	230 9.5	250 9.5	270 9.5	290 9.5	310 9.5
120	....	.....	.....	.....	.....	170 10.0	190 10.0	210 10.0	230 10.0	250 10.0	270 10.0	290 10.0	310 10.0
130	....	.....	.....	.....	.....	170 10.5	190 10.5	210 10.5	230 10.5	250 10.5	270 10.5	290 10.5	310 10.5
140	....	.....	.....	.....	.....	170 10.5	190 10.5	210 10.5	230 10.5	250 10.5	270 10.5	290 10.5	310 10.5
150	....	.....	.....	.....	.....	170 11.0	190 11.0	210 11.0	230 11.0	250 11.0	270 11.0	290 11.0	310 11.0
160	....	.....	.....	.....	.....	170 11.0	190 11.0	210 11.0	230 11.0	250 11.0	270 11.0	290 11.0	310 11.0
170	....	.....	.....	.....	.....	170 11.5	190 11.5	210 11.5	230 11.5	250 11.5	270 11.5	290 11.5	310 11.5
180	....	.....	.....	.....	.....	170 12.0	190 12.0	210 12.0	230 12.0	250 12.0	270 12.0	290 12.0	310 12.0
190	....	.....	.....	.....	.....	.....	190 12.0	210 12.0	230 12.0	250 12.0	270 12.0	290 12.0	310 12.0
200	....	.....	.....	.....	.....	.....	190 12.5	210 12.5	230 12.5	250 12.5	270 12.5	290 12.5	310 12.5

Courtesy Ceramic Data Book

ATOMICS

A New Section added to POWER PLANT ENGINEERING to cover current and forthcoming developments in atomic energy and related developments and applications in Nuclear Physics

Nuclear Energy and Electric Power

Part II*—The fundamental simplicity of the self-sustaining nuclear reactor . . . Commercial production of nuclear power not far away . . . Effect of nuclear power on transportation systems . . . Use of nuclear energy for heating . . . Uranium resources . . . Possibility of converting nuclear energy directly into elecric power . . . Thermal aspects of nuclear fission . . . Possible use of the radioactive effect of reactor in the generation of electric power

By **ANDREW W. KRAMER** Managing Editor, Power Plant Engineering

WHEN ONE STOPS to think about it, it is strange that the release of nuclear energy for power purposes can be brought about in such a very simple method as in the self-sustaining nuclear reaction pile.

In years past, in all research in nuclear physics all methods, as well as equipment involved, was of an extremely complex technical nature. It involved such highly specialized, complex things as cyclotrons, Van de Graaf generators, high-voltage cathode-ray tubes and other delicate electronic equipment. To produce even the minutest trace of radioactive isotypes required great skill on the part of the technicians operating the equipment in the laboratories. In the early days before the discovery of nuclear fission, anyone who speculated on the future possibility of utilizing nuclear energy did so in terms of cyclotrons or other ion accelerating equipment.

Merely a pile of Bricks

Yet in the self-sustaining nuclear reaction pile, nuclear energy is released by virtue of nothing more than a pile of graphite bricks in which lumps of uranium are imbedded. Nothing could be more simple. Even the combustion of coal in a furnace requires a more complicated arrangement. Furnaces with special grates or burners, water walls, draft equipment, etc. Even the theory, that is the understanding of the action of the pile, is simple as compared with that of the process of combustion of coal or other fuels. An understanding of the process of combustion requires a knowledge of basic chemistry, knowledge of principles of valence as well as the chemical and physical properties of carbon, oxygen, nitrogen, hydrogen, etc.

The process of nuclear fission is much simpler. All one needs to know is that when a slow neutron is captured by the nucleus of a U235 atom, the nucleus flies apart, explodes so to speak, the resultant particles going off at enormous speeds. The kinetic energy inherent in these high velocity fragments manifests itself largely as heat.

Given a supply of pure graphite blocks or bricks and a number of lumps of uranium, any person of ordinary intelligence and manual dexterity could build a self-sustaining nuclear reactor. It involves merely the orderly laying of the bricks in rows and layers and uniformly distributing the uranium through-

In this article we consider in somewhat greater detail than was done in the first article on this subject, further possibilities for the conversion of nuclear energy directly into electric power. In the first article in the March issue two possible schemes were suggested. As pointed out here, however, both of these schemes still involved the production of heat and the question arises, can we ever hope to convert nuclear energy into electric power without the production of heat? It appears unlikely. Thermal energy seems to be a universal manifestation of nature. Though atomic and nuclear phenomena may be electrical, in the ultimate analysis, statistically it manifests itself as heat. This is seen in all the stars and in the atomic bomb itself. If this is true another question presents itself; can we use the secondary effect of nuclear fission to produce electrical power, that is, the radioactive effect? As shown, it might be possible to do this but the efficiency is certain to be low. All these questions are purely speculative but they are worth considering and we would be pleased to see further discussion of this subject in these pages. Your criticism or comment is invited

* Part I of this article appeared on page 104 of the March isue.

out the structure as it grows. A child could do it.

You can't build a cyclotron—not easily

This cannot be said of a cyclotron or other nuclear research equipment. Nobody except skilled technical specialists could possibly put a cyclotron together, much less make the parts, no matter how much patience they had nor how many years they labored. And even if they were given a complete cyclotron fully equipped and connected to a source of power, it still would take considerable specialized knowledge even to operate it.

The point of all this is to make clear that the realization of nuclear power is much simpler than any of us could have supposed. This being so, it is reasonable to assume that the development of practical nuclear power plants will be much more rapid than we first supposed, especially along the lines proposed at present. Despite its newness, the commercial production of electric power from nuclear energy is only about five years away. Experimental production of power is almost certain to come within two or three years. The Daniels pile at Oak Ridge which will probably be completed this year, may produce some electric power next year, not, of course, on a commercial basis.

All central station power from nuclear energy in 20 years?

There are, in fact, highly respected scientists who predict privately that within 20 years substantially all central station power will be drawn from nuclear sources. If this prediction is even partly true, one can readily imagine what effect it will have upon the coal and oil industries and on the railroads and other transportation companies. To run a nuclear energy plant would require only a few hundred pounds of uranium a year.

An idea of the fuel economy of a uranium pile as a power source, may be obtained by comparing the bulk of a pound of uranium or plutonium with that of 1500 tons of coal, which gives, when burned, about the same energy as the pound of uranium or plutonium does when consumed in the pile. Similarly 250,000 gallons of fuel oil or 40,000,000 cubic feet of gas are also approximately equivalent to a pound of uranium. One pound of uranium or plutonium is capable of yielding almost 12 million kilowatt hours of energy, enough to supply the total power consumption of the country for a quarter of an hour. An atomic power plant operating at a million kilowatt level, thus needs only about two pounds of uranium or plutonium a day. A million kilowatt power plant, therefore, would require an annual fuel supply of only some 700 pounds of uranium. Compare this with more than a million tons of coal required for the same size plant and you will have some idea of what effect the use of nuclear power would have on the railroads which now have to transport this immense quantity of fuel. With nuclear power the annual fuel supply for a million kilowatt power plant could easily be flown to the plant by means of a small airplane, in one flight.

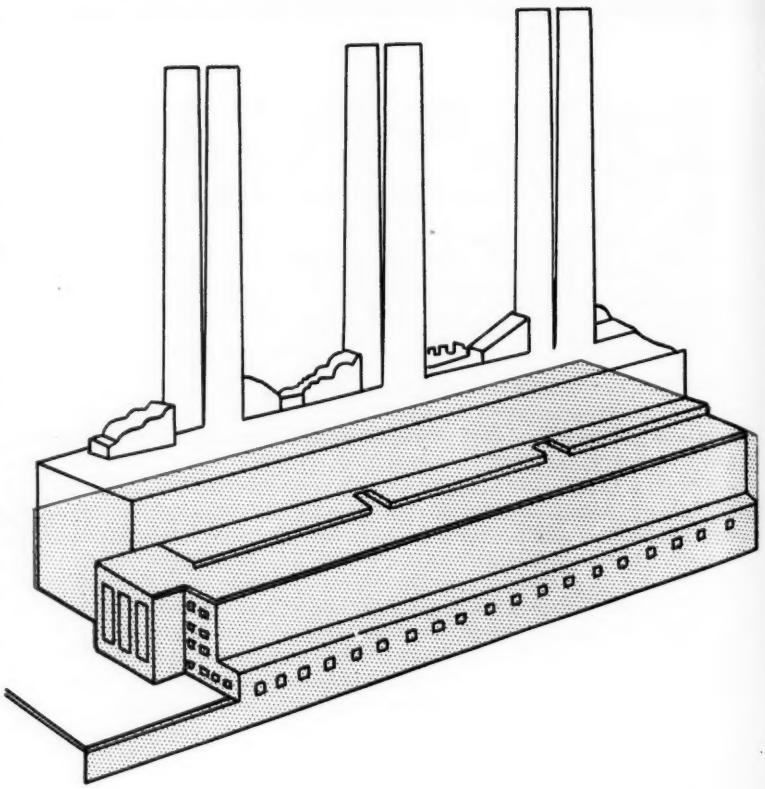
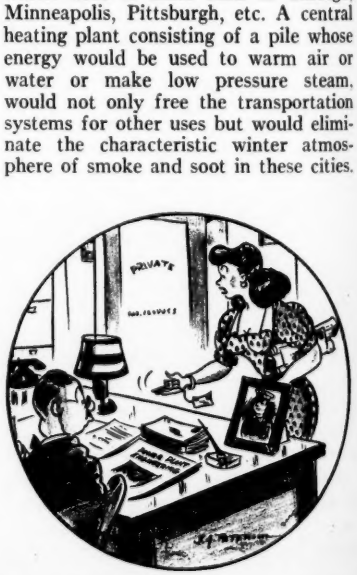


Fig. 1. If Cahokia Station at St. Louis were an atomic power plant it would not be greatly different from what it is today. It would be smaller if anything. The large boiler house would probably give way to a smaller "reactor" room while the turbine room would remain essentially the same as it is now

Delivering Fuel By Parcel Post

A million kilowatt electrical power plant operated by nuclear energy need be no larger than an ordinary big city power plant. The pile itself would be relatively small. Considerably smaller, no doubt, than the present boiler room, and there would be no smoke nor large fuel storage areas. As a matter of fact, the fuel for such a plant could be delivered on a day or week to week basis by parcel post.

In most considerations of the use of nuclear energy for power, the generation of electric power is assumed. One must remember, however, that most of the coal and oil burned in the United States is not for the production of electric power but for heating. That is, for heating homes, offices, factories, and for process work in industry. The building of nuclear energy heating plants would be quite simple, since in this case, the piles could operate at a lower temperature than that required for the production of high pressure steam in electric power plants. If water could be heated to a temperature of around 180 deg by nuclear reaction piles, it could be used for heating just as water heated by the combustion of coal or oil is now used for heating. Consider the train loads of fuel needed today to supply winter heat to cities such as Chicago, Minneapolis, Pittsburgh, etc. A central heating plant consisting of a pile whose energy would be used to warm air or water or make low pressure steam, would not only free the transportation systems for other uses but would eliminate the characteristic winter atmosphere of smoke and soot in these cities.



It just came in the mail. It's a month's supply of fuel for our atomic power plant

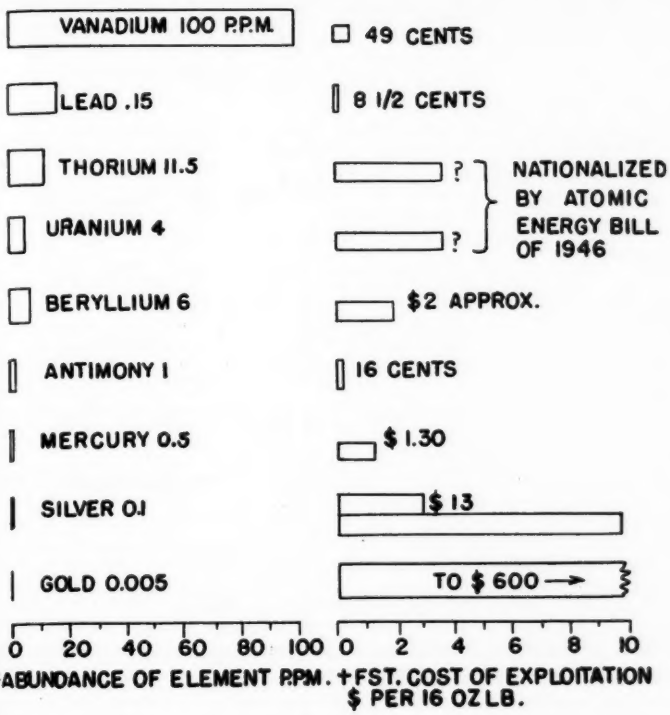


Fig. 2. Relative abundance and estimated exploitation of certain elements compared with uranium and thorium. (*As estimated by V. M. Goldschmidt. J. Chem. Soc. 655-73, 1937. †Based on approximate market prices in Eng. Min. J.)

It must be understood, of course, that though there would be an absence of smoke from such plants, the nuclear energy piles would be a source of intense and extremely dangerous radiation. And such heating plants would have to be very heavily shielded. This is a problem that would have to be overcome and it imposes grave but probably no insurmountable difficulties. No doubt these plans would be built deep underground, surrounded by heavy concrete, and fitted with ample control devices for protection. There is no fundamental reason why a nuclear energy pile cannot be operated in the heart of a city since control devices can be provided to insure absolutely safe operation.

Plenty of Uranium

We need not worry about the scarcity of uranium. While not of extremely common occurrence, it is far from being a rare element and it is widely distributed on the earth's surface. Rich deposits are known to be located in Canada, the Belgian Congo, Czechoslovakia, Portugal, Scandanavia and Russia. Recently a major uranium source is reported to have been discovered in the Argentine and it is almost certain that many other deposits will be discovered in the future. The relative abundance of uranium, however, is not closely related to availability. The uranium in most cases is locked up to the greatest extent in igneous rocks, among which it is sometimes found concentrated to a minor degree in coarse granite. While it is difficult and expensive to extract uranium from these granites, it does mean, however, that these low-grade uranium deposits are very abundant. It means that the world now has a huge reserve of fuel for power production. As time goes on, more economical methods may be found to extract uranium from the low-grade ores and we, therefore, have deposits of energy yielding minerals which will carry the human race through many centuries.

Of course, the first and foremost problem in the field of nuclear energy is the atomic bomb. Unless we can settle the questions imposed by the atomic bomb, it is almost useless for us to concern ourselves greatly over the peace time use of nuclear energy. No combination of national defenses is capable of giving us any assurance of safety in the event of a large scale attack with atomic weapons, and so our first task is to abolish atomic weapons by international agreement. While the statesmen and the politicians are arguing about the bomb, the scientists and engineers are actively engaged in the development of methods leading to the practical use of nuclear energy for power generation.

All present plans for power development merely substitute an atomic pile for a conventional steam boiler plant, utilizing the heat produced by the pile. But, as pointed out in another article,[1] presented recently in this section, atomic energy itself is an electrical force and it is possible that a means may be found to harness this force directly instead of using it to generate heat which must be reconverted into power.

Whether this can or cannot be accomplished, nobody knows. In the article referred to above, two methods were suggested. One involves the collection of dissociated electrons produced as a result of fission of U235 by slow neutron capture, and the other method assumes the release of thermionic electrons from a hot gas produced by nuclear fission.

It will be seen that despite the fact that the direct collection of electrons is assumed, both of these methods involve the release of heat because the very

[1] Nuclear Energy and Electric Power, page 104, March issue.

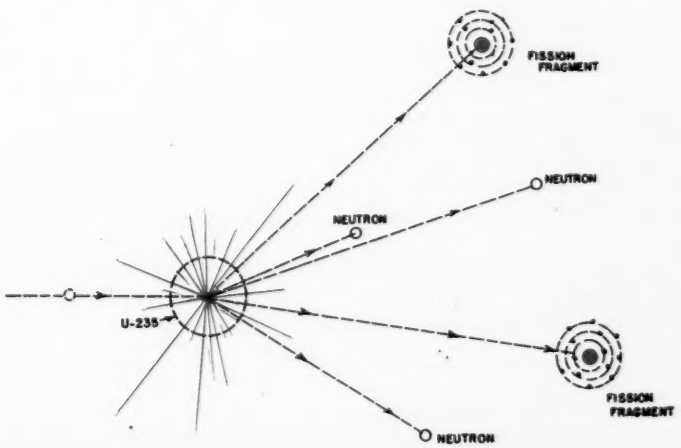


Fig. 3. When a uranium nucleus undergoes fission as a result of slow neutron capture the fragments fly apart at high velocity. This kinetic energy of the fragments is what we call thermal energy—energy of motion

process of uranium fission involves the production of heat. When the nucleus of an atom of U-235 breaks up as a result of slow neutron capture, the fragments fly apart at an enormous rate of speed; many thousands of miles per second. This in itself is heat, for heat as we all know is a phenomenon of motion and since in the case of nuclear fission the motion is very fast, the temperature is correspondingly high.

Most of the energy released in an atomic bomb chain reaction is in the form of heat and because the time of energy release is so short and the speed of the fragments so high, temperatures of millions of degrees are attained. This temperature instantly converts all the material of the bomb in the surrounding atmosphere into a large mass of hot glowing gas one-third of a mile across.

It is reasonable to suppose, therefore, that even though it might be possible to generate electricity directly from the fission of U-235, the process will always be accompanied by the release of a tremendous amount of heat. This is true in the case of the sun and the stars. The sun, as is well known, is the source of tremendous electrical activity and it sends out into space enormous electron streams which at times create violent electrical disturbances here on earth. Yet the sun is a mass of extremely hot gas kept hot by light nuclear reactions, as explained in an earlier article in this section.[2]

Of course, when we think of the release of heat in nuclear fission we need not think of it in terms of millions of degrees. In the plutonium pile, for example, the temperature of the pile as a whole is only a matter of a few score degrees. It can be maintained at almost any level desired. In this case, however, the low temperature is due to the fact that comparatively few fissions occur, and that the heat energy is integrated over the entire mass of the reactor.

Utilizing the Radioactive Effect

Instead of utilizing the direct energy of fission, it might be possible to utilize the secondary effect of the pile. That is, its ability to produce artificial radioactivity. It might be that this artificial radioactivity could be used for the generation of electrical power. Radioactive elements emit electrons and ions (Alpha particles) and it might be possible to collect these electrons and ions continuously and use them as a source of power.

Many years ago, Professor Strutt who later became Lord Rayleigh devised an interesting instrument, popularly known as the radium clock. It is the nearest approach to perpetual motion that has yet been devised. It consists of a gold leaf electroscope, worked by the negative electricity carried away from the radium by means of the beta rays. As shown in Fig. 5 a few milligrams of a salt of radium are contained in a thin walled closed glass tube, A, through which the beta rays can easily penetrate, and this tube is supported from an insulating quartz rod, B, within a highly exhausted glass vessel. The tube in turn carries at its lower end two gold leaves, C, as in an ordinary gold-leaf electroscope. The beta rays shot out from the radium carry away negative electricity, and therefore the radium itself left behind becomes positively charged. The gradual accumulation of this charge causes the gold leaves attached to the tube to diverge little by little, until they touch the sides of the vessel and are discharged. Thereafter the cycle of operation is repeated. An instrument of this kind will function, say every three minutes. There is no reason why such an instrument would not go on working for at least a thousand years, though at a slowly decreasing rate. Though not a perpetual motion machine, it is one as far as our lives are concerned.

Later on, H. G. J. Mosely, who discovered that all the elements can be arranged in accordance with the frequency of their x-ray spectra, hit upon the very ingenious idea of using the radium clock as a method of producing high electric potentials. If the clock is deprived of its leaves, if the insulating support can be made good enough and the vacuum sufficiently nearly perfect, there ought, theoretically, to be no limit to the extent the radium would become positively charged. In practice Mosely could not, with his particular apparatus, attain a potential much above 150,000 volts because at this point, a discharge through the vacuum always occurred. Nevertheless, the idea was sound and it proved that the disintegration of radium could develop high voltage electrical charges. Today, with more refined equipment it is possible that very much higher voltages could be produced in this manner.

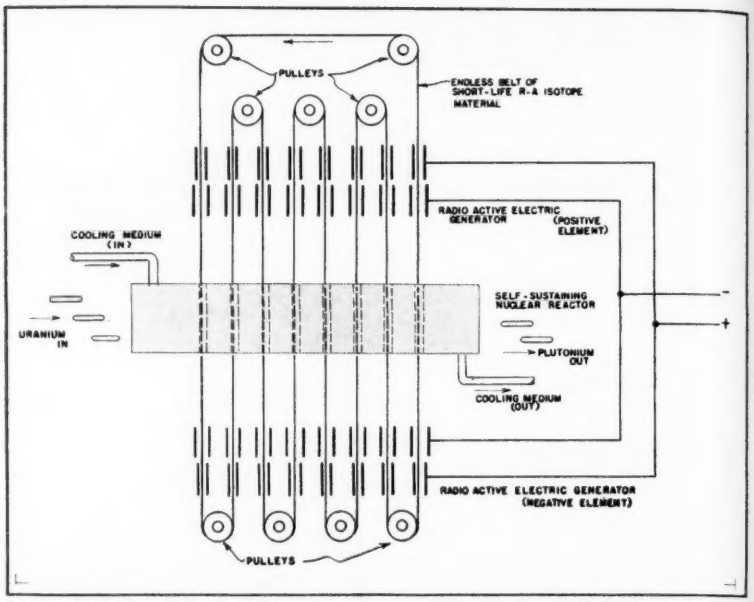


Fig. 4. Merely an idea, it probably won't work but it suggests a method for utilizing the radioactivity produced in a nuclear reactor for the production of electrical power. An endless belt made of some material which has a short radioactive life passes, serpentine fashion, through slots in the reactor. The alpha particles and the beta particles thrown off impart positive and negative charges to suitable collecting anodes and cathodes from which power can be drawn. This is only one of many possible arrangements that could be devised and the purpose of this sketch is largely to illustrate a principle rather than the arrangement itself.

Of interest here, is not the fact that high voltages can be produced by a modification of Lord Rayleigh's radium clock, but that radioactivity in any form can produce such charges. With the very high degree of radioactivity attained in the operation of a self sustaining nuclear reactor it might be possible to produce electrical power in this manner.

If electrical power could be produced in this way, however, only a very small portion of the nuclear energy available could be utilized, because, the bulk of this energy released would still be released as heat—the thermal energy of fission itself. Suppose, for example, we had an arrangement such as depicted in Fig. 4. It consists of a pile, through which is run in serpentine fashion an endless belt of some material which has a relatively short (a matter of minutes or seconds) radioactive life. This belt

[2] Eee Equals Em See Squared, page 80, February issue.

travels through slots in the pile so that it becomes radioactive as a result of neutron bombardment. On both sides of the pile, this radioactive belt passes through a grid or a bank of cells which constitute the electric generators. The charged particles emitted by the radioactive material of the belt are collected by an arrangement of cathodes and anodes in these generators and the electric power so produced (it would be direct current) could be utilized. The arrangement is a sort of modified Van de Graaf generator.

It will be readily apparent, that if such an arrangement could be made to work, the nuclear efficiency would be very low, because most of the energy of the fission of U-235 in the pile would be released as heat and this would have to be carried away by a cooling medium of some sort. Of course, the heat carried away in the cooling medium could be utilized but this would mean the use of heat exchangers, turbines or engines and conventional electric generators.

These ideas are nebulous but it is worth speculating about them. It is entirely possible, indeed, everything seems to point that way, that there is something in nature that will forever prevent us from converting nuclear energy directly into usable electric power. Nuclear energy, like all other manifestations of "thermal" energy we are familiar with, is "random" motion; it is disorganized and before we can use it, it has to be organized—changed into controlled motion. In the case of the chemical combustion of fuel, coal and oil, we accomplish this by means of the furnace and boiler. The random molecular motion of the hot gases in the furnace is transferred by radiation and convection to the molecules of water in the boiler, and the "pressure" so produced in the confined space of the boiler results in a "one-way" flow of energy to the engine or turbine.

In the proposed nuclear energy power plants such as the Daniels atomic power plant at Oak Ridge, the "random" thermal energy of fission will be similarly transformed into controlled energy by means of heat exchangers of some kind, and the high pressure steam or hot gas so produced will drive a steam or gas turbine.

No matter from what standpoint one approaches the problem, the element of thermal energy always raises its ugly head, so to speak. We cannot avoid it and in the end we may have to accept it as a principle in nature which we will always have to contend with. No matter where we look in the Universe, everywhere we see manifestations of thermal energy—of unorganized motion—electrons, protons, nuclei of atoms, all travelling, bouncing back and forth at enormous speeds in random fashion. Basically, the process is electrical—the forces involved are largely electrical, but from our standpoint, from a statistical standpoint, the process is thermal. Electricity is largely a man-made commodity. Very little of it seems to exist naturally. Somehow in our contemplation of the Universe, we never can get away from thermodynamics. God it seems is a thermodynamicist; only man specializes in electrodynamics. Hence if man wants to deal with electrodynamics in a practical manner, he has to convert nature's thermodynamic processes into electrodynamic processes by methods which inevitably are accompanied by a loss of a large portion of the available energy as heat. Perhaps that is the only way in which we can ever hope to utilize nuclear energy for power. If that is so, steam and electrical engineers today need have no worries that the development of startlingly new methods of generating electrical power will render existing knowledge and methods obsolete.

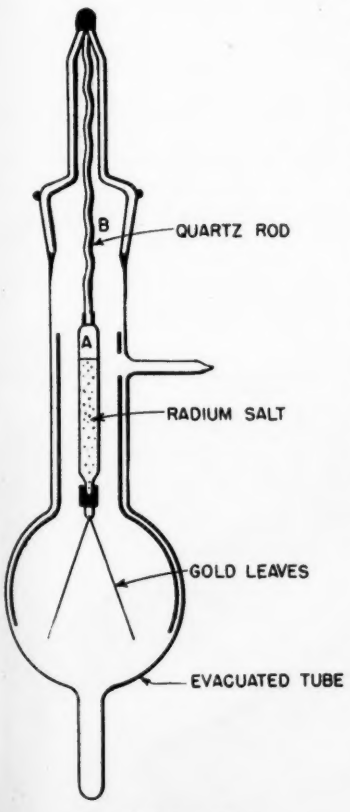


Fig. 5. Radium Clock

SAFETY WITH SOLVENTS

In MOST PLANTS, regular solvent operations are kept safe through proper ventilating systems and other controls. However, even in "safe" plants, employees may take it upon themselves to employ solvents for improper purposes, thus opening the way for fire or illness.

Control of solvent distribution within the plant can help to prevent unauthorized use of solvents. Such use, or rather misuse, of solvents is not only wasteful but it sometimes results in serious accidents which give rise to unwarranted fears of properly regulated solvent-using operations.

One fairly widespread example of unauthorized employment of solvents is their use for cleaning hands or clothing at the end of the day. When brought into frequent direct contact with the skin in this way, most solvents will cause drying, cracking, and infection. Improper handling of solvents in this manner may also result in inhalation of unsafe quantities of solvent vapor and, in addition, may create a fire hazard.

An unfortunate misuse of solvent occurred in one plant when an overly conscientious workman decided to clean the greasy floor around his work bench. For this purpose he employed a solvent which seemed to be doing an excellent job in a nearby degreasing machine. He did not realize, however, that the engineering apparatus which controlled the solvent vapor in the degreaser was not designed to provide protection for operations like his self-elected floor cleaning job. He spent several days at home recuperating from solvent vapor illness.

Taking solvents home for household use also has been the cause of a number of accidents. In one instance, an employee took home a large quantity which his wife used to clean a rug. Having no experience with or knowledge of the proper use of solvents, the housewife cleaned the entire carpet with the solvent, without opening any windows. The inhalation of concentrated solvent vapor resulted in her death several days later.

In other cases, flammable solvents have been taken home to do dry cleaning. Fire safety procedures, which are taken for granted in the plant, are often ignored in the home, with occasionally disastrous results.

Elimination of unauthorized solvent use is thus important to both management and employee, and should be a permanent part of the safety program.

—Safety Research Institute.

A SHORT-RANGE radar system, called Shoran, originally intended to make "through the overcast" bombing effective, may make it possible to map vast areas of the world never before charted. It is claimed that with Shoran-equipped aircraft, the distance of every point on the globe could be plotted within a few feet of any other point on the globe. In operation, triangulation, which is used to locate a specific point, is automatically computed by electronic devices. The Shoran operator needs only to watch 3 "pips" on a cathode-ray screen and turn 2 dials to keep the pips aligned, permitting him to read distances to ground stations on an automobile-type speedometer. Shoran was originally developed by the Air Technical Service Command, Radio Corp. of America, and the Minneapolis-Honeywell Regulator Co.

The Gas Turbine Power Plant—IV

By JOHN I. YELLOTT
Director of Research, Locomotive Development Committee, Bituminous Coal Research, Inc.

DETERMINATION of the quantity of fuel required in a particular gas turbine power plant requires an accurate knowledge of the "heating value" of that fuel. The difference between the higher and lower heating values of fuels is not generally considered in steam power plant practice, where the higher value is invariably used. The fuel consumption of a gas turbine, however, must be estimated upon the basis of "heating value at combustor outlet temperature," H_{B2}. The higher heating value of a fuel is determined by burning it in a calorimeter in which the water vapor from the hydrogen in the fuel is condensed and cooled down to the ambient air temperature. The lower heating value is found by assuming that the water vapor is not condensed, but remains in the form of superheated steam.

In other words, the latent heat of the water vapor, 970 Btu per lb at 14.7 psi, 212 F, is not recovered.

What is the Correct Heating Value?

Since each pound of hydrogen in the fuel burns to form 9 lb of water vapor, the usual correction is obtained by subtracting $(9 \times 970) \div 100 = 87$ Btu for each per cent of hydrogen in the fuel. For example, a fuel oil (Diesel grade) with 13 per cent H_2, 87 per cent C, and a higher heating value of 19,490 Btu per lb (140,520 Btu per gallon) will have a lower heating value of 19,490—$(87 \times 13) = 18{,}360$ Btu per lb.

The theoretically correct "heating value at the temperature of combustor outlet," is somewhat lower—about 4.5 per cent for oil and 4.0 per cent for coal—than the lower heating value. Mayers and Carter[1] give a good explanation of the calculations involved in determining the correct heating value for any kind of fuel when it is burned in a gas turbine combustor.

How to Calculate Fuel for Given Load

Having obtained a reliable heating value for the fuel which is to be used, the quantity needed at any given load on the power plant can be determined from the equation for combustor efficiency:

$$E_n = W_a (h_{n2} - h_{n1}) \div (W_f \times H_{n2}) = Q_a \div Q_f$$

Where E_n = Combustor efficiency
W_a = Pounds of air heated per hour
h_{n1}, h_{n2} = Enthalpy of air at inlet and outlet of combustor, Btu per lb.
W_f = Pounds of fuel per hour
H_{n2} = "Heating value of fuel at combustor outlet condition"
Q_a = Heat added to the air, Btu per hour
Q_f = Heating value of the fuel burned per hour

To return to the 4000-shaft hp gas turbine which has been used previously in Parts I, II and III as a numerical example, the combustor must heat 224,000 lb of air per hr from an inlet condition of 75 psi, 600 F, to a discharge condition of 74 psi, 1300 F. The necessary heat release is calculated from the numerator of equation (3).

$$W_a (h_{n2} - h_{n1} = 224{,}000 \times (343.5 - 160.5) = 40.4 \times 10^6 \text{ Btu/hr} \quad (4)$$

The volumes of air which must be accommodated are determined by finding the specific volumes at the inlet and outlet temperatures:

$$V_{n1} = 53.3 \times 1059.7 \div (144 \times 75) = 5.23; \quad CFM_{n1} = 19{,}600 \quad (5)$$

$$V_{n2} = 53.3 \times 1759.7 \div (144 \times 74) = 8.8; \quad CFM_{n2} = 32{,}800 \quad (6)$$

Excess Air and Fuel-Air Ratio Have Different Meanings in Gas Turbine Plant

Exact combustion calculations of the type used for steam power plants are not needed for most gas turbine estimates, since the concept of excess air has an entirely different significance. In the steam plant, excess air above the minimum needed to secure substantially complete combustion is harmful to plant efficiency, since it causes needless stack loss in the dry flue gases. In the gas turbine, a tremendous amount of excess air is essential in order to reduce the temperature of the combustion products to a value which can be tolerated by the turbine blades. An estimate of the air quantities involved in a gas turbine can be made by working backwards from the plant thermal efficiency, E_p,

$$Q_f = HP \times 2545 \times (100 \div E_p) \quad (7)$$

Where HP = Shaft hp of the plant
2545 = Heat equivalent of a horsepower hour, Btu
E_p = Plant thermal efficiency, per cent.

For example, a 4000-shaft-hp plant with a thermal efficiency of 25.2 per cent

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[1] The Elbow Combustion Chamber, *Transactions ASME*, May, 1946, page 395.

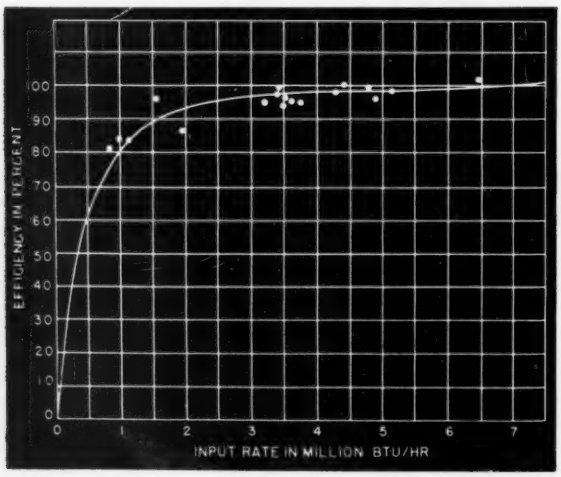


Fig. 1. Test Data for An Elbow-Type Combustor (Mayers and Carter, ASME)

Fig. 2—Below. View of Westinghouse combustors

Continuation of first textbook on how to design and build a complete gas turbine power plant today . . . Complete calculations for combustor, where the fuel is burned, carry on design begun in Part III . . . These are original calculations by the author, not available anywhere else in gas turbine literature . . . You have to figure how much fuel to burn for a particular gas turbine plant . . . How much air? . . . Excess air has new meaning here, for it may be from 600 to 800 per cent . . . Fuel-air ratio very important, but entirely different from that in steam boiler furnace . . . Also heating value of fuel must be accurately determined, for fuel consumption is based on "heating value at combustor outlet temperature" . . . Combustion calculations best made by Mol Method . . . Types of fuels . . . Combustion air temperature . . . Range of combustion less than in steam plant for varying load . . . Variation of gas turbine output controlled by regulating fuel supply . . . Details of actual combustors . . . This discussion of combustors continues that begun in Part III, April issue, because of importance of combustor design in practice . . . Complete design details and calculations for the gas turbine itself, originally planned for this part, will be Part V

requires a fuel supply capable of furnishing

$$Q_f = 4000 \times 2545 \times (100 \div 25.2) = 40.4 \times 10^6 \text{ Btu/hr} \quad (8)$$

The air theoretically required to burn this quantity of fuel will be very close to

$$40.4 \times 10^6 \times 750 \times 10^{-6} = 30{,}300 \text{ lb/hr} \quad (9)$$

since most fuels require about 750 lb of air per million Btu of higher heating value. (This approximation neglects the differences among the three forms of "heating value" mentioned previously.)

The theoretical quantity of air supplied to the combustor would be 30,300 ÷ 4000 = 7.57 lb per hp hr, while the actual air rate in this case is 224,000 ÷ 4000 = 56 lb per hp hr. The plant heat rate, HR_p, in this example would be

$$HR_p = 2545 \times (100 \div E_p) = 2545 \times (100 \div 25.2) = 10{,}120 \text{ Btu/hp hr} \quad (10)$$

The quantity of fuel and the air-fuel ratio will obviously depend upon the heating value of the fuel. If coal is used, with an assumed effective heating value of 13,000 Btu per lb, the "specific fuel consumption," to borrow a term from the automotive and aircraft fields, would be

$$w_f = 2545 \times 100 \div (E_p \times H_{n2}) = 10{,}120 \div 13{,}000 = 0.778 \text{ lb/hp hr} \quad (11)$$

and the fuel required per hour would be

$$W_f = 4000 \times 0.778 = 3110 \text{ lb per hr} \quad (12)$$

Effect of Combustor Efficiency

Combustor efficiencies for gas turbine plants must be quite high in order to maintain the plant efficiency at an attractive level. Mayers and Carter reported efficiencies between 96 per cent and 99 per cent for the Elliott elbow-type combustor, illustrated in Part III of this series. Tests of coal-fired combustors, made by Messrs. Buckley and Hazard at Battelle Institute for the Locomotive Development Committee, have shown that efficiencies in the vicinity of 96 per cent can be expected in actual operation. Aircraft gas turbines, which usually employ from six to twelve small "tin-can" combustors, can reach combustor efficiencies of 95 per cent to 98 per cent. Heat release rates, expressed in terms of Btu per hour per cu ft of combustor volume, have been reported as high as 10,000,000, although a more conservative value of 1,000,000 to 2,000,000 should be used in estimating combustion chamber dimensions. Figure 1 shows test results for an oil-fired elbow-type combustor.

How To Calculate Air-Fuel Ratio

In designing gas turbine combustors, the air-fuel ratio must be given first consideration. In the case being considered, 3110 lb of coal would be burned to heat 224,000 lb of air per hr from

Part I, January 1947 issue discussed cycles and equipment available for practical gas turbine plants; showed how to make preliminary calculations of plant performance and how a 5000-hp gas turbine plant would compare with a 5000-hp steam plant.

Part II, February issue, showed by *Gas Charts*, Mollier diagram and arithmetical calculations how to estimate plant performance, figure compressor back work, pressure losses, value of intercooling and regenerator surface.

Part III, April issue, showed how to calculate the requirements and details of compressors, how to design regenerators and calculate their dollar value, velocities of air in ducts, combustor efficiency and operation, insulation and metals used for combustors.

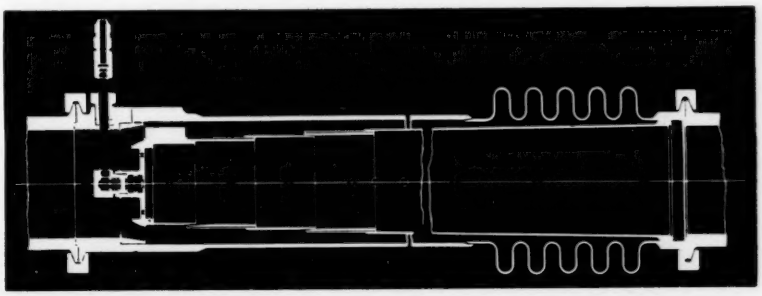


Fig. 3—Right. Diagram of Westinghouse combustors

Fig. 4—Below. Allis-Chalmers Annapolis combustors

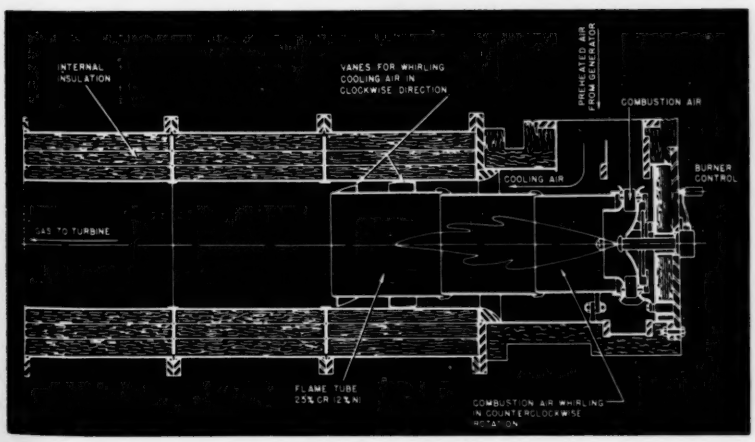
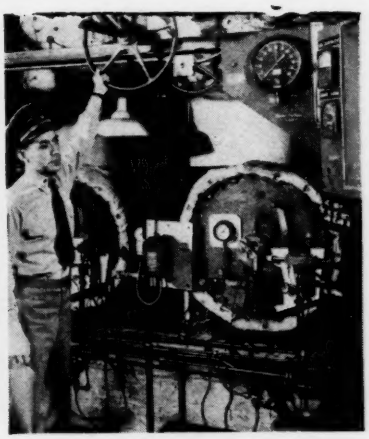


Fig. 5—Lower right. View of Allis-Chalmers combustor heads



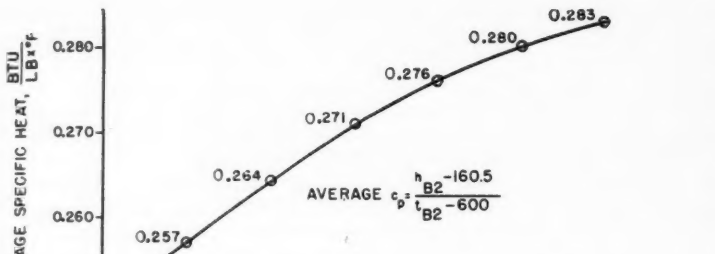


Fig. 6—Left. Average specific heat of air at high temperatures

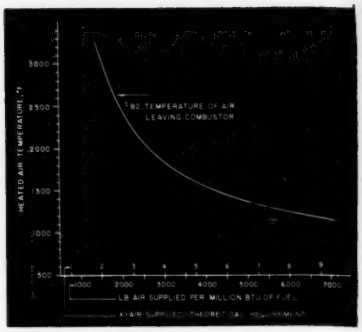


Fig. 7—Above. Air temperature leaving flame tube

600 F to 1300 F. Incidentally, the specific heat of air in this temperature range is 0.261 Btu per lb per degree F. [183 Btu per lb ÷ (1300 − 600)]. The air-fuel ratio is 224,000 ÷ 3110 = 72.0 lb per lb. The "excess air coefficient," defined as the ratio of the actual air supply to the theoretical or chemical requirement, is 72.0 ÷ 7.65 = 9.45. In other words, the actual supply is 9.45 times the theoretical requirement, while the percentage of excess air can be stated as 845 per cent.

An air-fuel ratio as high as 72.0 is far too great to support combustion, and so the air supply must be divided into "combustion air" and "cooling air." Physically this is accomplished by directing the major portion of the air stream around the flame tube, admitting to the tube only as much as can be used at each stage of the process. Figures 2 and 3 show how this is accomplished in the Westinghouse individual combustors. The Allis-Chalmers combustors in the Annapolis[2] gas turbine plant, installed in the Naval Engineering Experiment Station, are shown in Fig. 4. The external appearance of the heads of these combustors, with their controls, is shown in Fig. 5.

The distribution of the available air is based upon two considerations. Excess air supplied to the flame tube in the actual combustion zone should not exceed 25 per cent to 40 per cent, if excessive chilling of the flame is to be avoided. After the fuel has been virtually completely burned, the remaining air should be added as rapidly as possible. Addition of the air through a series of holes or orifices is an effective means of mixing the cooling air with the hot products of combustion.

The rise in temperature of the combustion air can be estimated from the following equation:

$$\Delta t = \frac{W_f}{W_{aB}} \times \frac{H_u}{c_p} \times E_B \qquad (13)$$

where W_{aB} refers to the quantity of air supplied to the flame tube per hour, and c_p is the average value of the specific heat of the air.

Air Temperature Rise in Combustor

Returning to the combustor, ($W_f \times H_B \times E_B$) is about 40.4×10^6 Btu per hour. If the regenerator delivers air at 600 F ($h_{B_1} = 160.5$) to the combustor, the temperature rise will, of course, depend upon how much of the total air is put through the flame tube. The average specific heat of the dry air will vary as shown in Fig. 6, as the air temperature ranges downward from a maximum of 3500 F. The temperature of the air emerging from the flame tube will vary with the total air supply in the manner shown in Fig. 7, calculated from the following equation:

$$t_{B2} = 600 + 40.4 \times 10^6 \div (W_{aB} \times c_p) \qquad (14)$$

In all the computations made for the combustor and the turbine, it has been assumed that the presence of the combustion products has not altered the properties of the air. The performance of a typical combustion calculation will show why this assumption is justified for most purposes.

Considering first a light oil, with 87 per cent carbon and 13 per cent hydrogen, we find, using the mol method, the results presented in Table I and Table II.

Effect of Water Vapor in Air

For turbine inlet temperatures of about 1300 F, the excess coefficient will range from 7.0 to 8.0, and the composi-

[2] U. S. Navy Operates 3500-hp Experimental Gas Turbine at 1350 F; POWER PLANT ENGINEERING, May, 1946, page 86.

Table I. Theoretical combustion calculations for light oil

Element	Lbs. per 100 lb Fuel	Molec. Weight	Mols per 100 lb Fuel	Mols O_2 Needed	Mols of Products	Product and Mol Wt.	Lb of Product
Carbon	87.0	12	7.25	7.25	7.25	CO_2,44	319
Hydrogen	13.0	2	6.50	3.25	6.50	H_2O,18	117
Oxygen	—	32	—	—	—	O_2,32	—
Nitrogen	—	28	—	—	39.70*	N_2,28	1,111
			Total mols O_2 needed =	10.50	53.45		1,547
			*Mols N_2 from air =	10.50 × 3.78 =	39.70		
			Lb air per lb fuel =	4.78 × $\frac{10.50}{100}$ × 28.8 =	14.47		

Note: This calculation assumes air to consist of 1.0 part of O_2, and 3.78 parts of N_2, with a molecular weight of 28.8.

CORRECTION NOTE—PART III

Several last minute typographical corrections on the proofs of Part III, April issue, were noted by the author and by ourselves just too late to make them before Part III went to press. Readers are requested, therefore to mark their copies of Part III to show the following corrections:

In Fig. 5, page 105, pressure ratio scale should read 1.0, 2.0, 3.0, 4.0, 5.0, 6.0. Decimal points on original drawing failed to come through in some copies.

Page 106—Column 1—Line 4 should read: The absolute velocity, V_3'. Line 11 should read: "The absolute velocity" instead of the relative velocity.

Page 106—Column 2—Paragraph 1—Line 2 should read: "Discharge." Paragraph 2—Line 12 should read: "The operating range of inlet temperatures."

Page 107—Column 1—Paragraph 3—Line 11 should read: "Is higher than either of the other two." Column 2—Paragraph 2—Line 6 should read: "Volumetric efficiency at a high level."

Also the following corrections should be made in Part II, February issue:

Page 79—Column 2—Line 6 should read R. B. Smith instead of R. R. Smith.

Page 76—Column 3—Paragraph 5. In equation (2) h_{c2} should be h_{C2}.

Table II. Combustion of light oil with excess air

Product	X = 1.0 Mols	%	X = 2.0 Mols	%	X = 4.0 Mols	%	X = 6.0 Mols	%	X = 8.0 Mols	%	X = 10.0 Mols	%
CO_2	7.25	13.5	7.25	7.0	7.25	3.5	7.25	2.4	7.25	1.8	7.25	1.4
H_2O	6.50	12.2	6.50	6.3	6.50	3.2	6.50	2.1	6.50	1.6	6.50	1.3
O_2	—	—	10.49	10.1	31.41	15.4	52.40	17.3	73.40	18.1	94.40	18.7
N_2	39.70	74.3	79.40	76.6	158.70	77.9	238.00	78.2	317.50	78.5	397.00	78.6
	53.45		103.64		203.86		304.15		404.65		505.15	

tion of the heated air will be as shown in Table III. The water vapor resulting from the burning of the hydrogen will be between 2.1 per cent and 1.6 per cent, and the CO_2 will be between 2.4 per cent and 1.8 per cent. If the intake air is humid, the water vapor in the heated air will be somewhat higher, since Tables I and II have been calculated for dry air. In order to show the effect of increased moisture, Table III presents the calculations for excess coefficients of 6 and 8, for air containing 54 grains of water vapor per pound of dry air. This is the specific humidity for atmospheric air at 70 F, 50 per cent relative humidity.

Table III. Combustion calculations for light oil with excess air and humidity* X = 6.0 and 8.0

	X = 6.0	X = 8.0
Lb air per lb fuel	86.82	115.76
Lb vapor per lb fuel	0.67	0.89
Mols vapor per 100 lb fuel	3.72	4.94
Mols H_2O from burning H_2	6.50	6.50
Total Mols H_2O	10.22	11.44

Combustion Products	Mols	%	Mols	%
CO_2	7.25	2.4	7.25	1.8
H_2O	10.22	3.0	11.44	3.6
O_2	52.40	17.1	73.40	17.9
N_2	238.00	77.5	317.50	77.6
	307.87		409.59	
Molecular Weight	28.8 lb/mol		28.7	
Gas Constant, R	53.5		53.6	

*70 F, 50% relative humidity, 54 grains vapor per lb dry air.

Molecular weights and gas constants for the atmospheres given in Table III vary less than one per cent from the values ordinarily used for dry air. The principal effect of water vapor is to raise the specific heat of the atmosphere. The injection of large quantities of water will raise the specific heat materially and will increase the ability of the air to do work in expanding through the turbine.

How to Make Combustion Calculations by Mol Method

Combustion calculations for gas turbine plants are readily performed by the mol method for solid and gaseous fuels as well as for liquids. Gas analyses are invariably given in percentage by volume, which can also be interpreted as representing the number of mols of each component per hundred mols of the gas. Solid fuel ultimate analyses are always given in weight percentages, and the procedure given in Tables I and II should be followed. A sample combustion calculation for a good grade of bituminous coal, with a higher heating value of 13,800 Btu per lb, is given in Tables IV and V which are presented primarily for the purpose of illustrating the problems arising when solid fuels are burned.

Figure 8 shows how the percentage of CO_2 and O_2 vary with the amount of the excess coefficient for both light oil and bituminous coal. It will be noted that there is almost no difference between the oxygen percentages for the two fuels at the higher excess air values.

Gas Turbine Fuel Supply Systems

The problems of supplying fuel to a gas turbine power plant differ from those encountered in Diesel and steam plant practice in several significant respects. The use of high-grade liquid fuels such as kerosene and distillate oils is relatively simple, since they can be pumped readily and controlled by valves or bypass systems. They are also easily ignited by sparks or other sources of internal heat. Since aircraft turbo-jet plants far outnumber all other types of gas turbines, their fuel supply systems deserve study as an example of successful solutions to the problem.

Turbo-jet units usually utilize kerosene, since the high volatility of gasoline is not required, nor is there any detonation problem. The pressure existing in a turbo-jet combustor at sea level take-off may be as high as 60 psia; so it is

Fig. 8—Below. Gas analysis

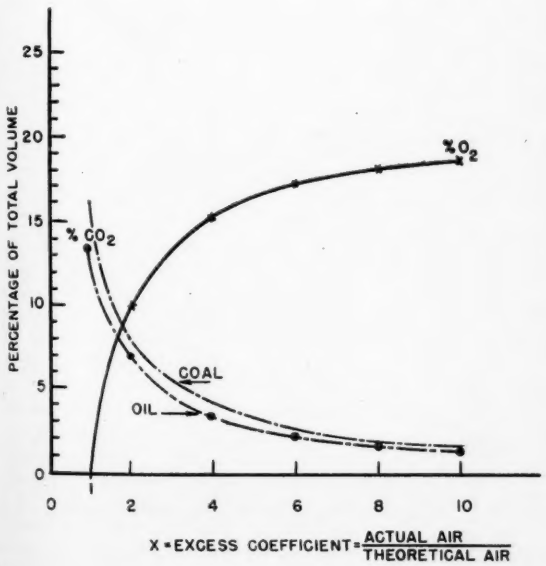


Fig. 9—Right. Fuel consumption, efficiency, etc. for Swiss unit

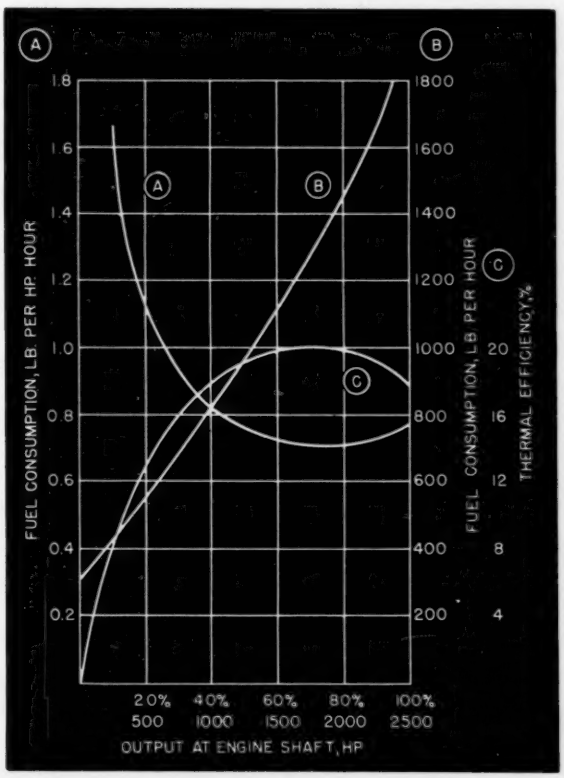


Table IV. Theoretical combustion calculations for bituminous coal

Element	Pounds per 100 lb	Mol Wt.	Mols per 100 lb	Mols O_2 Needed	Mols Prod.	Product & Mol. Wt.	Lb of Prod.
Carbon	71.98	12	6.0	6.00	6.00	CO_2, 44	264.0
Hydrogen	6.47	2	3.24	1.62	3.24	H_2O, 18	58.3
Sulfur	1.20	32	0.04	0.04	0.04	SO_2, 68	2.7
Oxygen	8.70	32	0.27	0.27	—	O_2, 32	—
Nitrogen	1.16	28	0.04	—	27.94	N_2, 28	785.0
Ash	10.49	Total O_2 needed = 7.39			37.22 = Total mols		10.5
						Total Products =	1,120.5

Mols N_2 from air $= 7.39 \times 3.78 = 27.90$

Lb air per lb fuel $= 4.78 \times \frac{7.39}{100} \times 28.8 = 10.20$

evident that the atomizing pump must be capable of producing a fine spray against a relatively high back pressure. Fuel quantities may run as high as 5000 lb per hr or about 12 gpm, and pressures at the nozzle inlet may reach 400 psi.

Service of this nature can be rendered by relatively small, high-speed gear pumps or by positive displacement, multi-piston pumps. Several designs have been developed in which the displacement can be varied almost instantly from zero to full flow by varying the angle of a wobble plate or a cylinder barrel. The power required by such pumps will be from 2.0 to 4.0 hp. The fineness of the droplets produced by typical atomizing nozzles has been studied by ingenious methods in many laboratories, and it has been demonstrated that droplets of 10 micron diameter[3] characterize the spray in turbojet combustors.

The range that must be covered by burners in gas turbine plants is considerably lower than that encountered in many steam plants. The fuel requirements at part load depend upon the method of governing, but, in general, the no-load or self-sustaining fuel consumption will usually be 15 per cent to 20 per cent of the full-load fuel rate.

How to Figure Fuel Consumption for Varying Load

Figure 9 shows the specific fuel consumption (lb per hp hr), thermal efficiency, and hourly fuel requirements for a 2500-shaft-hp locomotive-type gas turbine plant. These curves, taken from a paper by Paul Sidler of Brown-Boveri,[4] are based on the use of Bunker C fuel oil in a speed-governed regenerative cycle plant with a maximum turbine inlet temperature of 1112 F, and an ambient air temperature of 68 F. It is evident that the gas turbine fuel supply system must be prepared to cover a range of about 6-to-1, which can be readily accomplished with oil fuel.

Variation of the output of a gas-turbine plant is ordinarily accomplished simply by regulating the fuel supply. The governing system can, in turn, be adapted to keep the shaft speed constant and to vary the temperature of the heated air, or vice versa. For the generation of alternating current at constant frequency, constant speed is evidently necessary, but part-load efficiency suffers when this method is employed. Maintaining turbine inlet temperature at its maximum value, and reducing shaft speed to diminish power output, results in relatively good part-load efficiency. A more detailed discussion of this subject will be given in a later article of this series.

How to Estimate Fuel Requirements from Parsons Line

A more generalized concept of gas-turbine fuel requirements is obtained when the thermal efficiency data of Fig. 9 are translated into terms of plant heat rate and then into hourly heat requirements. A plot of hourly heat input in Btu against plant load is often called a Parsons line, in honor of the late Sir Charles Parsons. Since the gas turbine is not limited to liquid fuel, the Parsons line allows the requirements for fuel of any kind to be estimated readily.

Gaseous fuels are obviously well suited to the open-cycle plant, particularly if they happen to be available at a pressure high enough to permit direct injection into the combustor. When fuel requirements are expressed in terms of the Parsons line, the quantity of gas needed at any load can be determined easily . When the gas is available only at atmospheric pressure, the compressor work must be considered; but it should be borne in mind that the gas itself does work as its expands through the turbine. Thus there is no waste of efficiency when gas is compressed for use in the gas turbine plant, other than the loss caused by the fact that a separate, small, and hence lower efficiency compressor is necessary.

To summarize this section, the function of the combustor is to increase the temperature of the compressed air through (a) the burning of the fuel, and (b) the mixing of the combustion products with the cooling air. The fuel supply system is also charged with the responsibility of governing the plant, since the gas turbine normally employs no valves or other control means. Quick response of the fuel supply system to the governor's commands is essential. Stratification of the heated air is often a serious problem.

(*To be continued*)

[3] 25,000 microns = 1 in.

[4] Gas Turbine Locomotives for Main Line Service, by Paul R. Sidler; *Mechanical Engineering*, November, 1944, page 693.

Table V. Combustion calculations for bituminous coal with excess coefficients of 1, 4, 6, and 8

Product	X = 1.0 Mols	%	X = 4.0 Mols	%	X = 6.0 Mols	%	X = 8.0 Mols	%
CO_2	6.00	16.1	6.00	4.2	6.00	2.8	6.00	2.1
H_2O	3.24	8.7	3.24	2.3	3.24	1.5	3.24	1.1
SO_2	0.04	0.1	0.04	0.03	0.04	0.02	0.04	0.01
O_2	—	—	22.17	15.5	36.95	17.2	51.83	18.2
N_2	27.94	75.1	111.64	78.0	167.40	78.3	223.20	78.6
	37.22		143.09		213.63		284.31	

A NEW LACQUER has been formulated by Roxalin Flexible Finishes, Inc. especially for spray coating polystyrene used for refrigerator parts such as freezer compartment doors and temperature dials. The new coating withstands humidity and low temperatures and etches only slightly so that good adherence to the smooth polystyrene surface is assured. The coating is dried by air and can be flashed off in a matter of minutes, thereby meeting production line speed requirements. The lacquer is also characterized by resistance to soap and food acids, fastness to ultraviolet light, resistance to cracking and peeling, toughness, and good luster. A wipe-in lacquer with good resistance properties has also been developed to obviate use of spraying equipment and is to be applied with such simple tools as brush and dropper.

BY USE OF appropriate circuits and relatively simple waveguide systems, a new microwave radio tube, developed by Sylvania Electric Products, Inc., can be built into the production lines to perform control inspection, and grading operations. The tubes are said to be suitable for such purposes as the detection of faults of structure, moisture content, impurities, surface hardness of metals, ripeness of fruits, and other product characteristics. The magnitude of the electrical changes produced as the products pass through the microwave system varies with the nature and condition of the material and can be amplified to operate relays that adjust the production line, control sorting mechanisms, or operate quality recording apparatus. The tubes include 1,000-to-5,000-mc. receiving and low power transmitting types.

Midwest Power Conference Studies Present Problems, Looks Ahead

SPONSORED by the Illinois Institute of Technology, with the co-operation of the ASME, AIEE, WSE and various Midwestern universities and engineering colleges, the 1947 Midwest Power Conference was held at the Palmer House, Chicago, on March 31, April 1 and 2. The thousand or more power engineers and executives attending the conference heard a varied program of papers dealing with the problems of designing and operating the power plants and systems we have today, which must go on while the gas turbines, panel heating, electronic controls, heat pumps, cyclone furnaces, synthetic fuels from coal and the like, are being developed for tomorrow. And always in the background $E = MC^2$. The conference cast a thoughtful look ahead at the shape of the future but the peace-time job of making the present work received the principal emphasis. Problems of designing and operating coal-fired power plants, water treatment, fluctuating industrial power loads, electric distribution systems, improvement of small power plants, safety, high-pressure and high temperature metallurgy, hydraulic power, paper mill power—we must cope with these while working to make the future arrive. The engineer's responsibilities as a citizen and the role of power in future military preparedness plans were also emphasized.

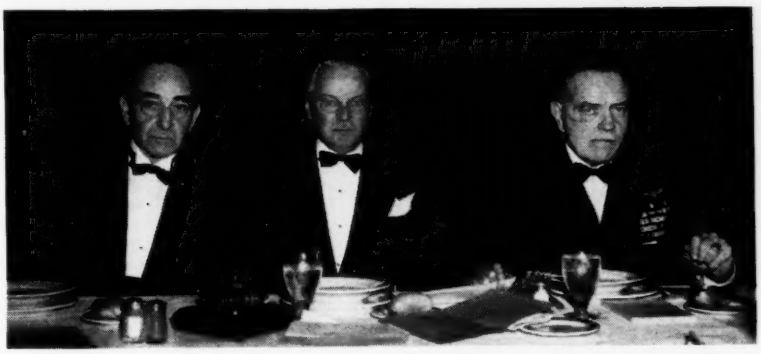


Fig. 2. Speakers at "All-Engineers" Dinner, 1947 Midwest Power Conference. Left to right: Richard B. Deupree, James D. Cunningham, (Toastmaster), Fleet Admiral Wm. F. Halsey, USN

Fuels and Combustion

Central Station Combustion Control Problems were analyzed by Charles H. Smoot of Republic Flow Meters Co. He outlined the basic requirements for control of fuel, air and furnace pressure in boiler furnaces and showed the various methods of co-ordinating them to overcome certain inherent difficulties.

Accurate methods of obtaining an air flow measurement are important and are sometimes difficult when, for example, by-passes around an air preheater or superheat by-pass dampers are used or when slag accumulations in the boiler are rapid. The best method is to design the forced draft duct work to contain a venturi section measuring all the air used for combustion.

Mr. Smoot reviewed the various devices—control valves, dampers, variable speed devices—for actuating flows in a boiler system, and showed how their speed of response affected the entire response of the boiler. He also discussed devices for use when simultaneous firing of multiple fuels or the same fuel from multiple sources brings up the need for totalizing two or more air flows that vary according to the square relationship.

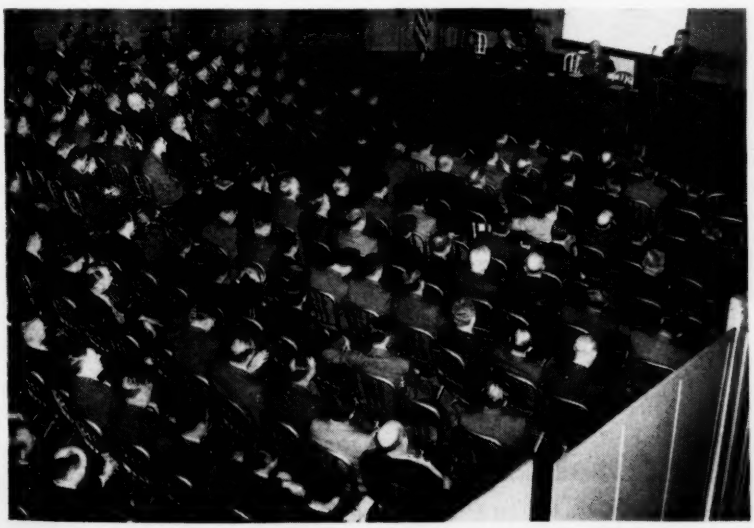


Fig. 1. General view of one of the technical sessions, 1947 Midwest Power Conference

Safety

Other comments on automatic control were also given at the same session in a paper on Inspection for Safety of Power Plant Equipment by William D. Halsey, chief engineer, Boiler Division, Hartford Steam Boiler Inspection & Insurance Co., the paper being read in Mr. Halsey's absence by W. E. Glennon of that company. Mr. Halsey suggested that the manufacturers of control equipment consider the establishment of performance standards for control devices. Although his company welcomes the trend to automatic controls as an aid in operation, nevertheless there are constantly increasing accidents from failure of automatic devices. If the solution for these is not found by industry, insurance rates will inevitably be forced upward, he said. He discussed many aspects of power plant safety in equipment and operating practices and his comments will be presented fully in a future issue.

Power for the Paper Industry depends on both the particular paper manufacturing processes used, the water supply available (for water is the conveying medium in a paper mill and water also may supply hydraulic power) the power and steam balance, power for compressed air and power for pumping. Quality of water for both processes and boiler feed must receive careful attention. Steam pressure and temperatures for paper processing affect the generation of power. These and other factors,

(*Continued on page 158*)

Bellefield Boiler Plant Continues Expansion

By **ROGER D. SPELLMAN,** Chief Engineer, The Rust Engineering Co.

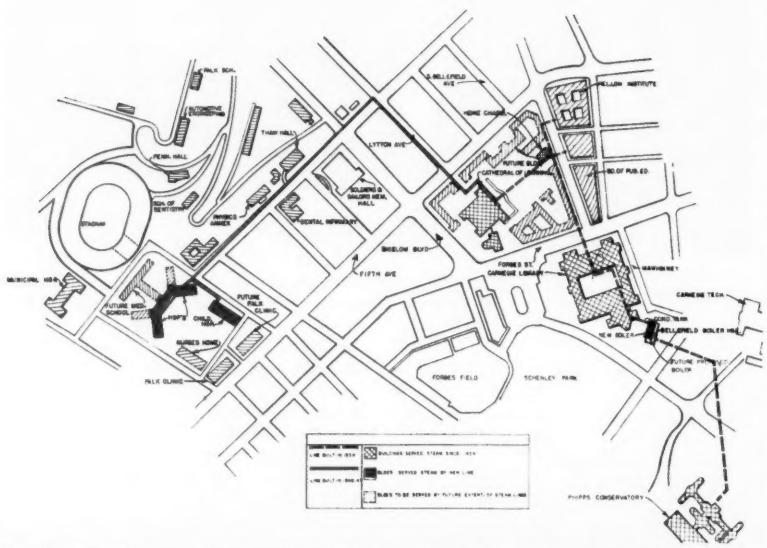


Fig. 1. General plan of Pittsburgh Civic Center, showing steam distribution lines including 1946 extension

Fig. 2. New 85,000-lb-per-hr boiler and stoker under installation at Bellefield Boiler Plant

THE PRESENT expansion program at Bellefield Boiler Plant in Pittsburgh's Civic Center calls attention to the steady growth and increased usefulness that can be achieved by a jointly-owned, non-profit steam plant when under efficient operation.

In 1904, the Carnegie Institute Library and Museum building was finished; the Institute built a steam plant in Panther Hollow, just behind the building and adjacent to railroad service. Eight boilers were installed, with pivoted bucket carrier conveyor lifting the coal to overhead bunkers and also removing the ashes to an overhead bunker. A 195 ft brick chimney was erected; and steam lines were laid to the Institute.

Phipps Conservatory, an extensive greenhouse in Schenley Park which had been given to the City of Pittsburgh in 1893, became the second user of steam from the 1904 plant. In 1926 the University of Pittsburgh began building the Cathedral of Learning nearby and a few years later the new Mellon Institute building was started. The steam distribution system, including the present expansion, is shown in Fig. 1.

First Plant Expansion

In 1933, Carnegie Institute, Carnegie Library, University of Pittsburgh and Mellon Institute made an agreement that officially instituted the Bellefield Boiler Plant as a joint steam supply operation. A Bellefield Boiler Plant Supervisory Committee decided to modernize the Library's Panther Hollow plant into a central steam supply.

The eight original boilers were abandoned, and The Rust Engineering Co. installed two modern Springfield cross-drum boilers, each capable of delivering 75,000 lb of steam per hour at 175 psi pressure. Westinghouse multiple retort underfeed stokers were installed to fire the boilers. A gravity coal feed system to the stoker hoppers was included that weighs automatically and records each 200 lb of coal drawn from the bunkers.

A water treatment plant was installed to protect the boilers from hard scale and corrosion. City water was used but was first treated by a hot lime-and-soda process softener and then filtered. It was pre-heated to near boiling temperature and fed to a deaerating heater, where the excess oxygen was removed, and was then pumped by the boiler feed pumps to the boilers.

Steam plant built in 1904 has served Pittsburgh's civic center as a jointly-owned, non-profit enterprise since 1933 . . . Brief history of development . . . Economic considerations and division of operating costs . . . Present expansion adds 50 per cent to steam output to serve Pittsburgh Medical Center . . . New 85,000-lb-per-hr boiler fired by underfeed stoker . . . Coal and ash handling facilities expanded . . . Water treatment system also extended

Fig. 3. Welding condensate return line on Bellefield steam line extension to serve 4 hospitals

Water treating costs were reduced and the boilers further protected by feeding the condensate back into the system at a point between the filter and the deaerating heater. Five-inch copper lines were installed to carry the condensate returns to a large storage tank by gravity, at temperatures averaging between 150 and 170 F. A reserve head of 6 ft was kept in the condensate storage tank, and treated city water made up the balance of the 100,000 lb per hr of water circulated hourly.

When recently examined, after more than 10 years, the internal boiler surfaces showed very slight corrosion and no hard scale. This good condition was interpreted as evidence of the efficiency of the water treatment system. As a result of this system, which remains in operation, the life of the boilers has been extended enough to greatly reduce depreciation costs. The manner in which the existing system is being extended to care for the new unit is shown in Fig. 5.

Economy of operation was also provided by the large capacity boilers, modern stokers and automatic combustion control, which give nearly smokeless combustion.

The combustion control system utilized air pressure to transmit power to control draft dampers and regulate the speed of the stoker and forced draft fan. This system has consistently maintained the 175-psi pressure within 2 or 3 lb.

Production Costs

Production efficiency of the plant has been high since operation began, with an average of 8.5 lb of steam delivered per pound of coal burned. Maximum production of steam, (including that used by plant auxiliaries), has been 9.5 lb per pound of coal or higher.

When the plant opened in 1934, it supplied steam to the institutions at 20 cents per 1,000 lb. Since then, costs of fuel, labor and material have increased the cost to 45 cents per 1000 lb at present. Even with this increase, the Bellefield plant supplies steam at a very considerable saving over the cost of individual steam supply systems in the buildings.

Operating expenditures have been divided between the institutions in accordance with the quantity of steam used; while depreciation and obsolescence costs are apportioned according to capital investment needed to supply maximum steam demands of each building.

Steam flow is measured at the boiler plant by recording flow meters. Steam costs are pro-rated to buildings served with a common line, according to data from similar flow meters on the branch lines to each institution. Condensate returns are credited similarly. Steam lines in use are two 12-in. lines to Carnegie Library, a 4-in. line to Phipps Conservatory, and 12-in. and 8-in. common line extending to the Cathedral of Learning for the other buildings served.

The Present Expansion

The 1933 agreement anticipated the growth of the Civic Center and nearby Medical Center, and gave the operating committee authority to expand the generating capacity and to furnish steam to other buildings of non-profit institutions. Since that agreement the Board of Education building and the Young Mens and Womens Hebrew Association have been added to the University of Pittsburgh-Mellon Institute common line supplied with steam by the Bellefield plant.

In 1946, Rust was called in to in-

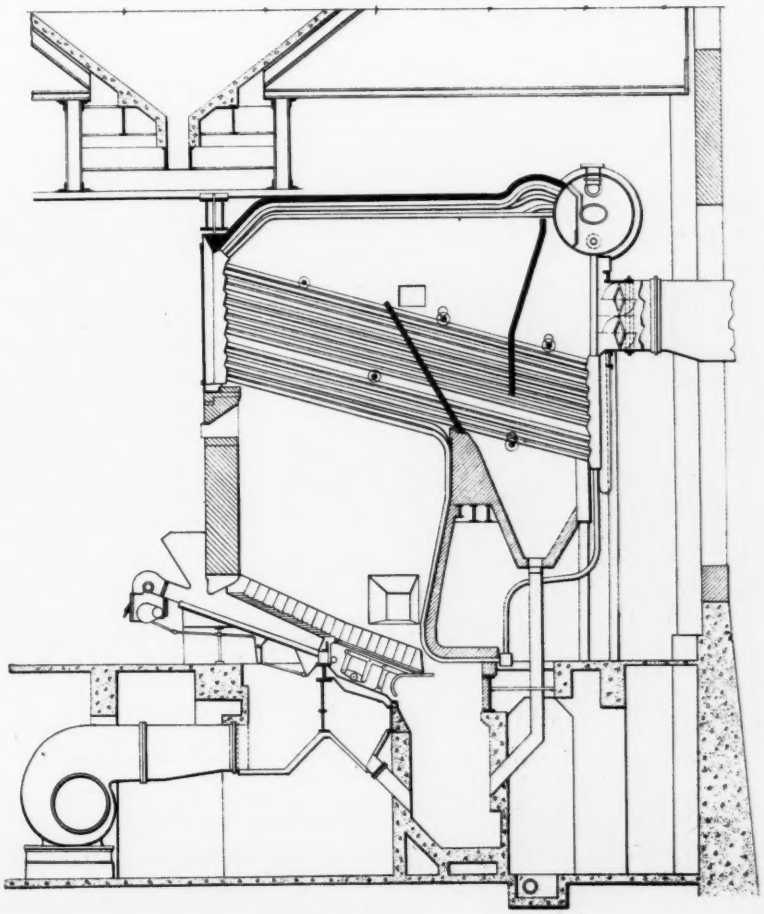


Fig. 4. Cross-section of 85,000-lb-per-hr Springfield boiler installed in Bellefield Boiler Plant in 1946

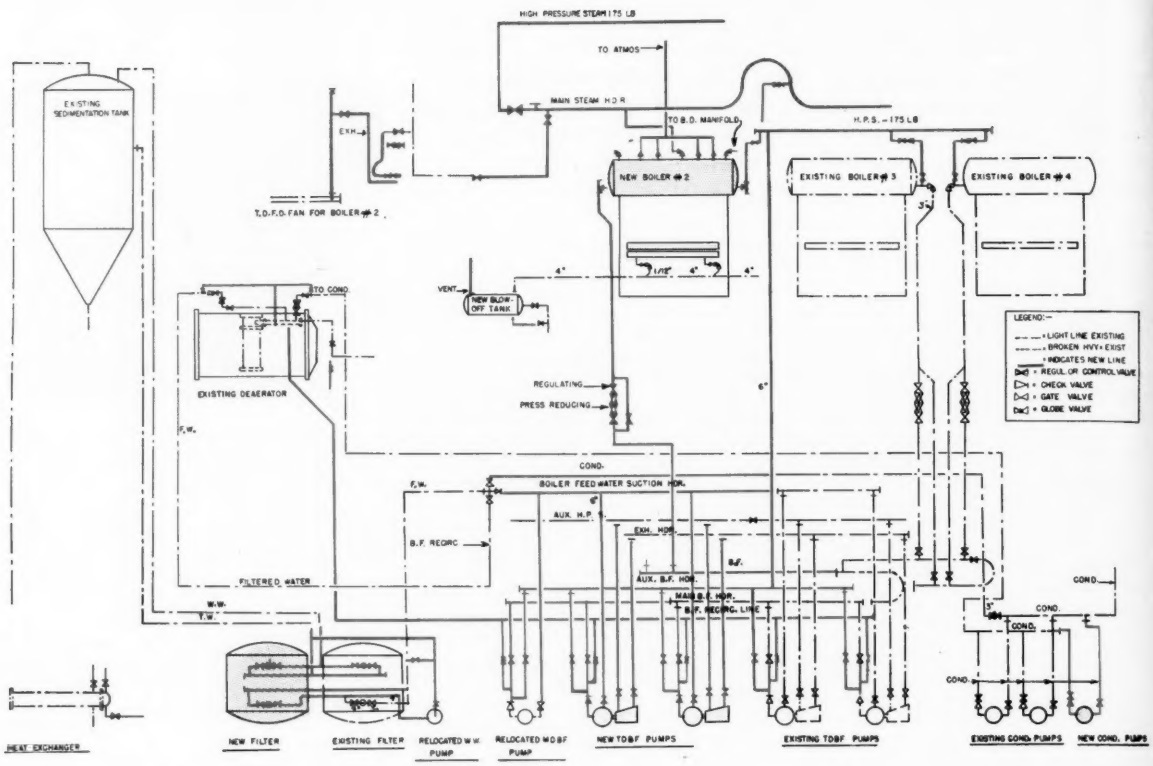


Fig. 5. Schematic piping diagram showing how existing feedwater and steam piping systems are extended to serve new 85,000-lb-per-hr Boiler No. 2

crease the capacity of the plant in order to supply steam to four hospitals in Pittsburgh's growing Medical Center. The present work, now nearing completion, will add 50 per cent to the steam output and will extend steam lines to Children's, Presbyterian, Eye and Ear, and Woman's Hospitals.

As part of this program a new Springfield boiler of modern design is being installed in the plant as shown in Fig 2. It is designed to produce 85,000 lb of

Fig. 6. View of 1946 steam distribution line extension near U of P's Cathedral of Learning

PRINCIPAL NEW EQUIPMENT—1946 EXTENSION BELLEFIELD BOILER

Serving Civic Center, Pittsburgh, Penna.

Boiler (1) Springfield Boiler Co. Cross-drum, sectional-heater, water-tube boiler, with water-cooled bridge-wall. 85,000 lb per hr maximum continuous capacity. Heating surface: 10,430 sq ft, exclusive of water wall. Design pressure: 250 psig. Present operating pressure: 175 psig. No superheat. Boiler set 16 ft from floor to bottom of uptake headers. Boiler furnace width: 16 ft, 10½ in. Vulcan soot blowers. Swartwout feedwater regulator.

Stoker (1) Westinghouse Electric Corp. Multiple-retort, link-grate, continuous-ash discharge stoker—9 retort. Effective length of grate surface: 11 ft 2 in. Stoker furnace width: 16 ft 1 in. Stoker drive: turbine, with reserve variable-speed d-c motor. Direct current supplied by small motor generator set. Hydraulic link grate drive.

Forced Draft Fan (1) B. F. Sturtevant Co. (Div. of Westinghouse Elec. Corp.) No. 85 turbo-vane forced-draft fan. Double-inlet, double-width; 30,000 cfm 5 in. static pressure; driven through Fast flexible coupling by one 33 hp, 3615/1295-rpm Elliott turbine with reduction gear.

Combustion Control Hagan Corp. Controlling boiler outlet damper, stoker speed, and both fan speed and fan outlet damper on forced draft. This is an extension of the existing Hagan system.

Boiler Panel (1) Bailey Meter Co. With following instruments:
1 Bailey boiler meter—steam flow, air flow, flue gas temperature.
1 Bailey draft gage—forced draft, stoker, windbox, link grate, overfire, and uptake drafts.
1 Bailey smoke recorder.
1 Bailey feedwater level recorder.
1 Hays CO_2 meter—indicating and recording.
Hagan controls and gages are mounted on this panel.

Boiler Feed Pumps (2) Buffalo Pumps, Inc. Four-stage, type RR boiler feed pumps. Each 215 gpm against discharge head of 755 ft. Speed 3,500 rpm and driven by two 62-hp 3,500-rpm Elliott type 2 BY turbines, with differential pressure governors.

Condensate Pump (1) Frederick Iron & Steel Co. DSV-S, 2-in. single-stage condensate pump; 195 gpm against 30 ft head. Speed: 1750 rpm; driven by Elliott 5-hp induction motor.

Ash Handling Equipment (1) United Conveyor Corp. "Nuveyor" system to serve all boilers and discharge to existing ash bunkers.

Coal Handling Equipment—present bunker to stoker Stock Engineering Co. 2 coal valves; 2 automatic scales, 200 lb capacity each; 2 conical spreaders.

Breeching; Duct Work and Boiler Casing Scottdale Foundry and Machine Co. Boiler served by present 200 ft x 9 ft radial brick chimney.

1 Additional filter for hot process softener Cochrane Corp.

Piping National Valve and Manufacturing Co.

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IMPACTOR Handwheel Closes big valves in little spaces against high pressures with sledge-hammer blows, saving the cost of motor operators and the bulk of toggle operators.

EValthrust Yoke Bushing—Double combination angular—radial ball bearings to insure smooth, positive closing.

EVALIZING An exclusive plating process which reduces friction between moving steel parts by approximately 50 per cent.

EVinlay A hardened bearing surface for bonnet nuts and stem contact areas on the disks of large high-temperature valves to prevent seizing and galling.

EValpak Heat resisting molded packing of graphite-impregnated asbestos, especially formed for Edward stuffing boxes

Equalizer Permits full lift of piston in non-return and check valves for lower pressure drop.

INTEX Integral seat valves of extra value; for pressures to 1500 lb at 950 F.

UNIVALVE Integral bonnet forged steel valves for service extremes.

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Edward Valves, Inc.

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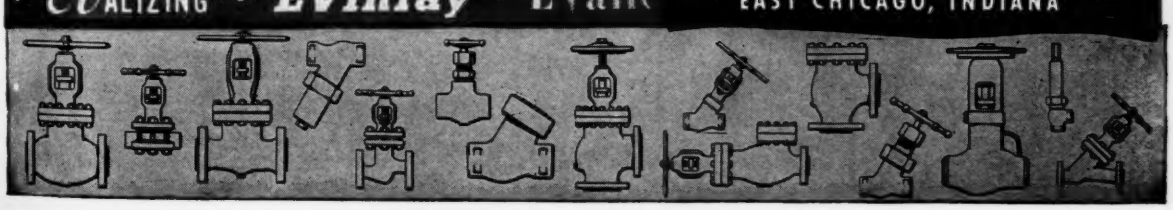

steam per hour and is fired by a Westinghouse stoker with water-cooled bridge-wall. Other auxiliaries, similar to those installed with the two boilers in 1934, are being provided.

Complete details of this new boiler unit and all the auxiliary equipment being installed in connection with it are given in the attached list of equipment. The boiler cross-section is shown in Fig. 4 and the unit while under erection is shown in Fig. 2.

To increase coal and ash handling facilities, a pneumatic ash removal system, is being installed, so that existing mechanical conveyor can handle coal exclusively. The present single-conveyor system has been used for ash removal two hours a day, reducing the time available to unload incoming coal—a situation the new equipment will remedy.

Coal is delivered to the plant by railroad cars pulled into the building on an elevated siding. The coal is weighed in the cars, dumped, and carried by a McCaslin conveyor to coal bunkers. Four cars of coal can be emptied in six hours by this method.

The four additional hospitals will receive steam through two 10-in. lines extended from the 12 and 8-in. lines now serving the Cathedral and Mellon Institute. The condensate return line of the extended system, Fig. 3, is 5-in. red brass pipe. Extension of the lines has just been completed.

To increase the steam supply when the service is again extended, another boiler will have to be installed and an additional chimney constructed. Room exists to install such a fourth boiler in addition to the present three.

Radar Technique In Industrial Control

In this abstract of a paper delivered by the author before the Winter meeting of the American Institute of Electrical Engineers, he describes one example of how certain types of pulse circuits, widely used in radar work, are applied in side register control of machines such as printing presses, paper machines, textile manufacturing equipment and other processing machines where accurate alignment of a web or strip is required

By W. D. COCKRELL Industrial Engineering Division, General Electric Co., Schenectady, N.Y.

FOR A LONG TIME, industrial electronic engineers and communication engineers have felt that their circuits and techniques had little in common, that the one dealt with low frequencies and high power, whereas the other dealt with high frequencies and often with signals of extremely small power. However, with the development of such special communication fields as radar and loran, it has been found that many new circuits have been adopted in the communication field which are also quite useful in the industrial field. Therefore, it is highly desirable that the progressive electronic engineer in either field keep close contact with developments in the other so that he may take advantage of those which he may best use. Circuits such as square-wave circuits, clippers, blocking, timing, and counting circuits normally associated with radar have an equally important place in industrial electronic circuits. In fact, the circuit to be described was designed before the war and before the present radar circuits were made available to the industrial engineer.

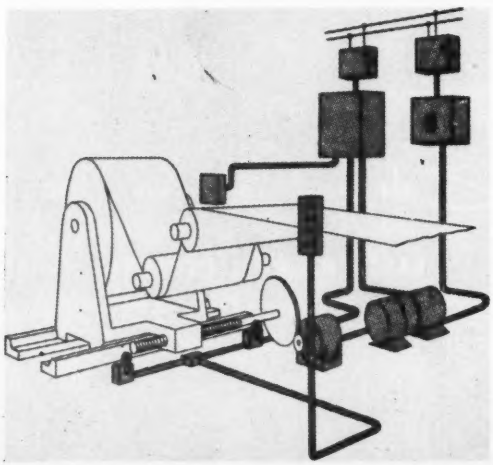

Fig. 1. The fundamental parts of a side-register control system

In the paper and printing industry, on slitting and processing machines where an accurate alignment of a web or strip is required, it is very desirable that the strip be wound or unwound so that its edge or a line of printing on it shall follow an exact path. The basic mechanical operation will be seen from the simplified sketch in Fig. 1. A "photoelectric scanning head," shown in the center above the strip, views the strip edge or a printed line. Any deviation from the correct path is signalled to the electronic control panel at the right to excite an amplidyne generator. The amplidyne drives a correcting motor which moves the feed roll sidewise to correct the position or "register" of the strip.

The Photoelectric Scanning Method

The photoelectric means, developed to accomplish this result, operate as follows:

Because the most sensitive phototubes change their characteristics slowly over a period of time, it is desirable to operate on a sudden change of light, rather than on a continuous amount of light. To obtain a sudden change of light reaching the phototube, as reflected from the printing or edge of web, an optical system is used. It consists of four lenses mounted on a disk which is turned by a sychronous motor. The image of a lamp filament is projected through the lens onto the paper, and as

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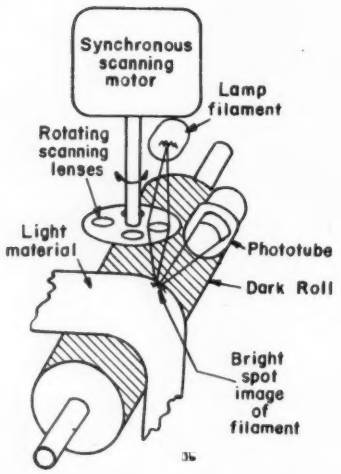

Fig. 2. A photoelectric scanner with rotating lens system

the lens moves this small spot of light describes a quarter circle. As the rotor of the small synchronous motor turns in accord with the electric voltage wave form, the position of the spot at any instant is directly related to the instantaneous value of the electric voltage driving the motor. Therefore, as the spot sweeps past the change in color corresponding to the register point, the change of phototube signal may be matched in time with the instantaneous value of the a-c voltage. In this way, a corrective action may be set up if the register point is not in its correct position. The photoelectric scanning head including the optical system and phototube is set up so that the correct register position corresponds approximately to the midpoint of the light arc.

The principle of determining accurately the arrival of an electric pulse is the fundamental of radar. Although here such extreme accuracy is not needed, we must determine times before, as well as after, the reference instants.

The use of the rotating-lens optical system to operate a reversing motor on an "on-off" basis is not new, but the circuits developed to provide a signal proportional to the direction and amount of misregister do involve a number of "radar-like" circuit elements and should be of interest. A previous system provided only that if the light spot occurred earlier or later than a critical phase angle that the correcting motor would be driven in a forward or reverse direction. However, inherent hunting action caused an excessive wear on the correcting mechanism and was not completely satisfactory. A circuit was needed which could apply a correction nearly proportional to the distance away from register so that the corrective action might be smooth and the motor might remain at standstill when no correction was needed.

Circuit Requirements

As outlined briefly, we must compare:

(1) An amplified phototube signal which has a comparatively steep wave front at the instant the light spot crosses the edge of the material or the printed line which will be used for register. Since the width of the line is indeterminate, and the surface over which the light passes afterwards cannot be controlled, it is desired to eliminate the phototube signal for the rest of the cycle as soon as the register signal has been obtained.

(2) The instantaneous value of the sine wave a-c voltage which is indicative of the position of the moving light spot.

Our first step is to change the phototube signal into a uniform pulse and to eliminate all of the undesirable signals which the phototube may pick up.

Input and Pulse-forming Circuit

In order to transform the somewhat indefinite signals coming in from the phototutbe amplifier into a consistent signal, our first step is to use it to trigger a square-wave or "gate" circuit. If we refer to Fig. 3, we see that this consists of a twin triode tube 3V with common cathode resistor 11R, and with the grid of the second triode driven from the anode of the first by a voltage divider, 13R and 14R, to provide snap action from full current to cut-off whenever the first grid passes a critical voltage. Switches are provided in the phototube amplifier so that the triggering signal is always in a positive direction.

The small circles at the top of the figures enclose oscilloscope traces of typical wave forms at the points indicated.

The Circuit Action—The Signal Trips

Before the circuit is tripped, the first triode 3aV, is normally non-conducting while the second, 3bV, is conducting with zero grid voltage. When a positive pulse is applied by the phototube amplifier to the grid of the first tube through the capacitor 4C, the first tube 3aV begins to conduct, its anode is drawn towards the cathode, and the grid of the second tube—through the voltage divider 13R and 14R—is driven sharply negative cutting off the second triode. The cathodes fall in potential permitting full current to flow through the first triode 3aV. This instant in the operating cycle is shown at point "A" in the oscillograph traces above the diagram.

The grid of tube 3bV is driven well negative below the 3aV grid return point, 40, so that no further action of the phototube amplifier will be effective to cut off the first tube. If the signal from the phototube amplifier should go far negative, as shown in the oscillograph trace, the rectifier element of 4aV limits the voltage to near point 40 and prevents any further negative swing.

Thus, we have accomplished the first requirement of obtaining a definite signal from the phototube and preventing any further signals from causing operation. We have developed a "triggered gate circuit" with "rectifier blocking of reverse action."

Circuit Resetting Means

However, in order to make the circuit "alive" for the next cycle, we must reset it. This is done by means of an a-c voltage obtained from the transformer 2T and the phase-shift circuit 13C and 44R which provides a sine wave of the proper magnitude and phase.

Rectifier 4bV is so connected that during the positive part of this sine wave, 4bV is not conducting and the

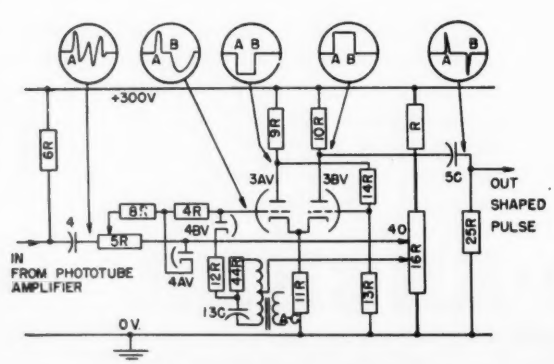

Fig. 3. Input and pulse-forming circuits

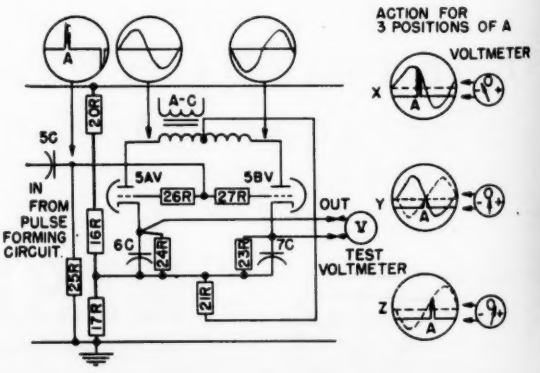

Fig. 4. Error-detection circuit, for polarity and magnitude

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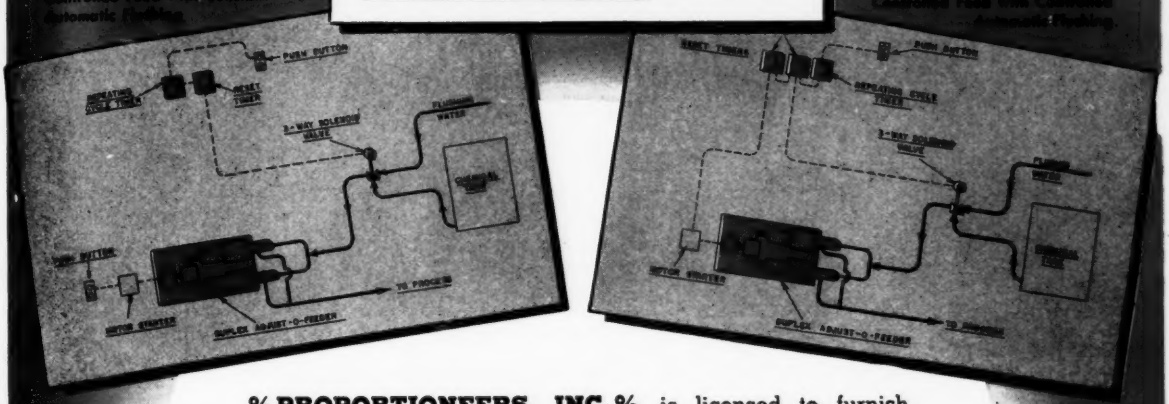

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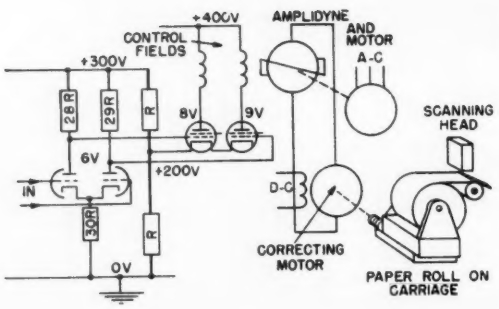


Fig. 5. Output circuits and mechanical system

reset circuit is disconnected. However, as this reset voltage swings negative (as it does near the end of the light-beam sweep) 4bV conducts and so draws the grid of 3aV far negative. This stops 3aV from conducting and resets the circuit. Furthermore, so long as the reset voltage is negative, 3aV cannot conduct and signals from the phototube remain ineffective until the reset voltage again swings positive and releases the 3aV grid. Point "B" on the oscillograph traces indicates the beginning of the reset time.

The Pulse or "Pip" Circuit

The signal which we wish to use as the indication of the instant of tripping is a very sharp pulse of positive voltage. This is obtained by coupling a very small capacitor to the anode of the second tube 3bV so that the output plate of the capacitor will be drawn quickly positive when the tube 3bV stops conducting, but will rapidly recharge to its original condition. The voltage appearing at the output of this portion of the circuit is shown in the right-hand oscillograph trace.

The output signal from this portion of the circuit consists of a single uniform pulse, accurately timed to the passage of the light spot past the paper edge or register line. This occurs once each electric cycle.

Error Detection Circuit

In this circuit (Fig. 4), we compare the instant of passage of the light spot past the register line, as indicated by the uniform pulse which we have produced and the relative position of the light spot in its sweep, as determined by the instantaneous value of the voltage driving the synchronous motor. Since this voltage is a sine wave, which we may change in magnitude or reverse in phase easily by means of transformers, it provides a very desirable signal for our purpose. The relation between the voltage wave and light spot may be preset by the location of the lens disk on the motor shaft.

In practice, we confine ourselves to a 90-degree arc of movement. Since the scanner motor operates at 1800 rpm, this allows ½ cycle (at 60 cycles) for operation. In a properly phased sine wave, the voltage swings from a positive maximum through zero to a negative maximum. If we apply this sine wave to the anode of a tube and use the pulse on the grid to permit conduction at the proper instant, we will release a brief surge of current corresponding to the instantaneous voltage applied. Thus, if we should phase our optical system so that the correct register point corresponds to the zero voltage of the sine wave, we can obtain a current flow proportional both to direction and distance from register.

Since an electronic tube is a rectifier and cannot pass current in both directions, we use two tubes: one which is supplied with voltage from one phase, and the other from the opposite phase of the transformer. These are shown at 5aV and 5bV in Fig. 4. If the positive pulses are applied to the grids of both tubes, each cycle, only that tube which responds to the direction of error will conduct current.

At this point, we have obtained a definite signal corresponding to the direction and amount of misregister but it appears only as short pulse of current which would be ineffective in operating a motor drive.

The Pulse-Smoothing Circuit

In order to obtain a useful signal from the current pulses, they are used to charge two capacitors, 6C and 7C, of Fig. 4.

The capacitor charges are drained off by shunt resistors, and as the current pulses arrive each cycle, each capacitor assumes a fairly constant voltage proportional to the charge received. The output from this part of the circuit is taken from the positive plates of the capacitors. The voltage between these leads is a comparatively smooth d-c, indicating both by magnitude and polarity the amount of misregister.

The oscilloscope traces and voltmeters at the right in Fig. 4 indicate three possible actions of this circuit. At the top, "X," the pip has occurred before the zero point of the a-c cycle so that the left-hand tube 5aV has conducted, charging 6C. We will assume that the pointer of a zero-center voltmeter applied across the output leads would swing to the left.

In the condition "Y," the register is correct. The pip cuts the a-c wave at the zero-voltage point and small, equal charges appear on both 6C and 7C. The voltmeter indicates zero.

Finally, at "Z," the pip occurs late. Tube 5bV charges 7C and the voltmeter pointer swings to the right.

Once the misregister has been converted into a d-c voltage, a number of means are available to provide power for the correcting motor. These include power electronic circuits, electromagnetic means, and the usual rotating exciters and d-c generators. In this particular application, we will assume a fast-response generator, requiring low excitation power, known as the amplidyne.

The two balanced control fields which excite the amplidyne are supplied by a pair of output pentode tubes. These, in turn, are fed by a balanced voltage amplifier whose grids are responsive to the capacitor potential indicating the misregister. This voltage-amplifier stage consists of a balanced cathode-follower circuit sometimes given the descriptive name "long-tailed pair."

Circuit Refinement

In an article devoted to the fundamental features of a circuit it is always desirable to eliminate those subordinate circuits which, while necessary in a practical design, tend to confuse a newcomer who wishes to trace the fundamental circuits. In the commercial equipment, there are rectifiers to supply d-c and filters for obtaining good wave form. Stabilizing or anti-hunt circuits are provided to obtain fast response with maximum circuit stability. Motor switches and protection are needed as well as push-button stations to permit manual operation of the correcting motor while setting up the equipment.

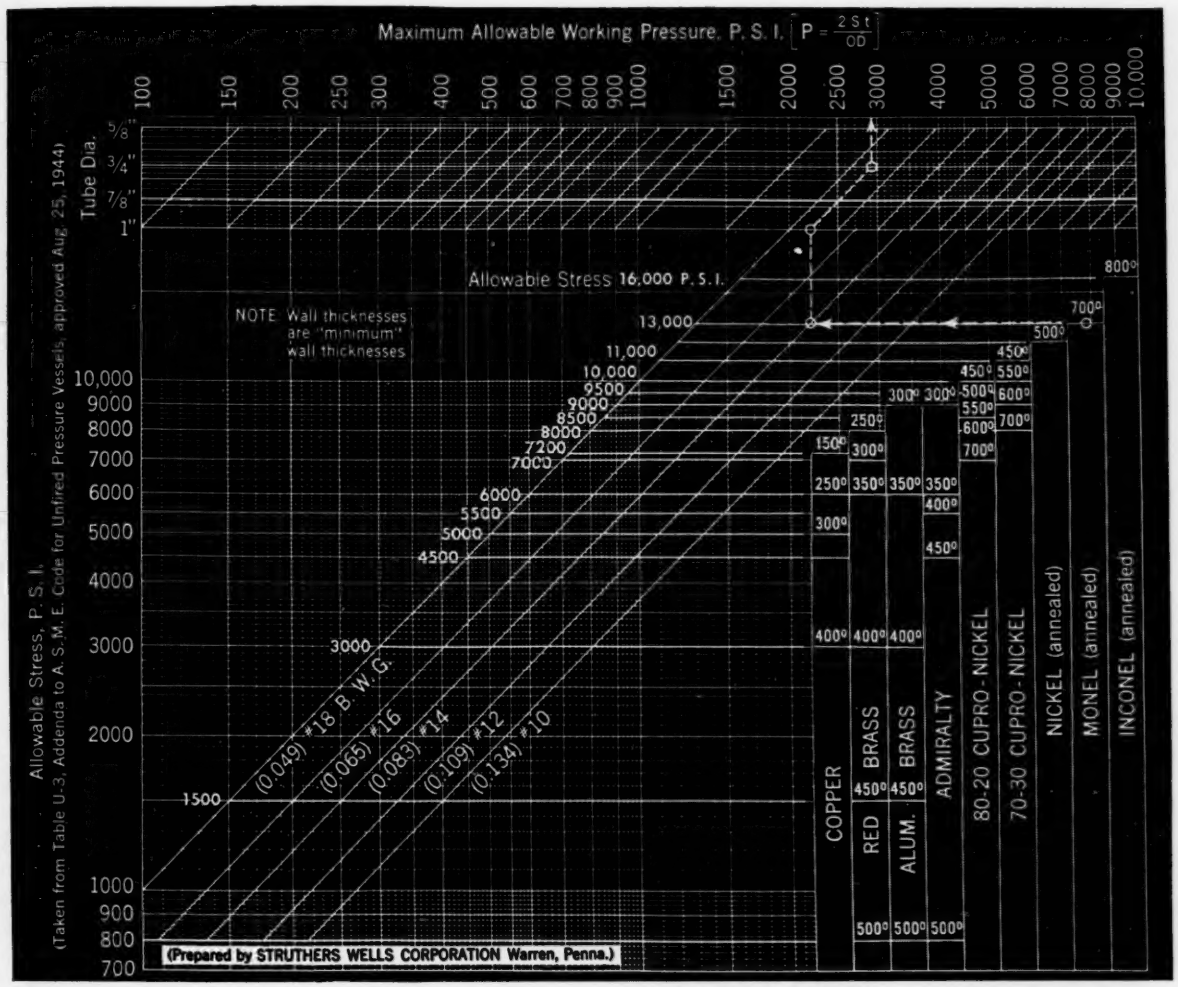
Conclusion

In this description of a typical industrial electronic application, we have tried to show that the elementary electronic tube circuits familiar to the radar man are not limited to one field only, but can be combined and arranged to serve many functional requirements.

SEAMS OF preformed tubes may now be automatically and continuously welded by a new Berkeley welder developed by Penn Tool and Machine Co. The new welder is claimed to save much time, may be operated by unskilled help, does not produce fumes, and the operator is not required to wear protective clothing. Operation consists merely of feeding the preformed tubes continuously into one end of the machine. Tubes emerge from the opposite end with uniformly welded seams that are of X-ray quality and require no further finishing. Seams are welded at the rate of 50 to 250 ipm. (depending on thickness of the metal being welded) by an automatic electric arc submerged in a granular flux. The company is currently manufacturing 6 models varying from 84 to 120 in. long, 54 to 96 in. wide, and 60 to 108 in. high, for welding tubes 4 to 21 in. in diameter.

How to select PRESSURE TUBING

This chart quickly gives you the MAXIMUM ALLOWABLE WORKING PRESSURES under the A.S.M.E. Unified Pressure Vessel Code for given wall thicknesses and outside diameters of typical non-ferrous tubing in U-tube constructions



HOW TO USE CHART

Sample problem: Find the maximum allowable working pressure for ¾" O.D. Monel* tubing with a wall thickness of 0.083" (#14 B.W.G.).

1. Enter the grey column labeled MONEL. Go to its top, at the 13,000 P.S.I. Allowable Stress level.
2. Move left along the 13,000 P.S.I. level until it intersects the diagonal labeled (0.083) #14 B.W.G.
3. From this point of intersection, move vertically up to the horizontal line marked 1" Tube Dia.
4. From this new point of intersection, move diagonally to the upper right, keeping parallel to the diagonal lines, until you reach the horizontal line marked ¾" Tube Dia.
5. Vertically above this final point of intersection, is the maximum allowable working pressure — approximately 2,880 P.S.I.

PRESSURE TUBING of Monel, Nickel or Inconel* offers outstanding usefulness wherever high pressures and temperatures are involved. For example, these strong, thermally-durable alloys are ideal for U-tube high-pressure feedwater preheaters. *Reg. U. S. Pat. Off.

Reprints of this Time-Saving Chart are available upon request.

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Inspection of Unfired Pressure Vessels

Unfired pressure vessel is not just a tank; it is part of a pressure system . . . All parts of system demand proper design . . . Causes of failures . . . Prevention of failures requires adequate preventive maintenance program . . . This should be established as part of design, operating and production routine . . . Proper records are vital . . . How to hold "production balance" . . . Effects of overloading on deterioration . . . Factor of safety always decreasing unless preventive maintenance is practiced by co-operative effort

By JAMES J. DUGGAN Carbide and Carbon Chemicals Corp.

IN THE PAST 15 or 20 years, the use of high pressure equipment in the manufacture of many of our present-day commodities has been greatly increased. During this period, many new techniques have been developed by the designer and technician to produce equipment suitable for the processes involved, and operating methods have naturally followed that have enabled the equipment to produce the desired product with a greater degree of efficiency and safety.

Like all modern progress, these advanced techniques have been incorporated in the various codes and standards covering the subject. For the purpose of this discussion we will refer to all standards and all codes* as "The Code."

The existing written Code is general in scope and covers, directly or by inference, the fundamentals for safe operational requirements, but admittedly does not cover all specific details for any one complete specific requirement. Therefore, what I shall term an "unwritten" or "individual" code comes into being that covers the specific operational "Know-How" requirements, and completes the overall requirement for a specific service. This latter individual code must of a necessity be supplied by the individual engineer or engineering group within each company or unit. The specific data would therefore be the result of the experience or known requirement of a particular industry.

A pressure vessel is generally thought of as a single individual tank in which materials are stored or collected under various pressures and temperatures. This is basically true; however, one has only to consider the numerous types of vessels used today in the vastly expanding chemical industry, for instance, to appreciate that each must be looked upon as a specific unit and that each must be operated and treated with full consideration of its mechanical limitations and design features.

There is a definite relationship between a vessel under presure and the material in process. Proper design, fabrication, and installation must be based on this relationship, otherwise the vessel may become a magazine of almost unlimited energy constituting a serious hazard.

Pressure Vessel is Part of a System

A vessel, in the majority of instances, is only a part of a system. For example, consider a simple compression system as in Fig. 1. When this system is in operation, all connecting piping, the condenser or cooler, and all appurtenances connected thereto become a part of a system. Therefore, should not the piping, condenser, compressor cylinders, etc., be built for the same maximum requirement as the pressure vessel itself?

The following features must be considered because they are part of the system. Failure of any one of these might cause abnormal conditions in other parts of the system with resultant destruction. For instance:

1. Should not the safety valve on the compressor be of sufficient capacity to prevent overpressure in the compressor

From a paper before the National Safety Congress, Chicago.

* Particular reference is made to the ASME and the API-ASME Codes for unfired pressure vessel design, the NFPA Code for fire protection, and the NSC Safe Practice Pamphlets and Data Sheets for safety.

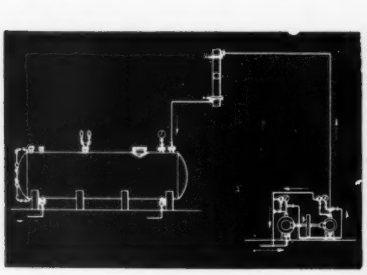


Fig. 1—above. Diagram showing how unfired pressure vessels form parts of a compression system

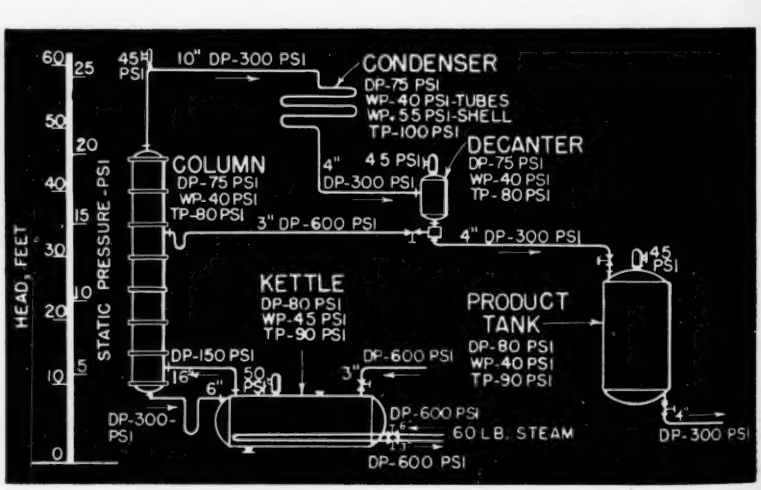
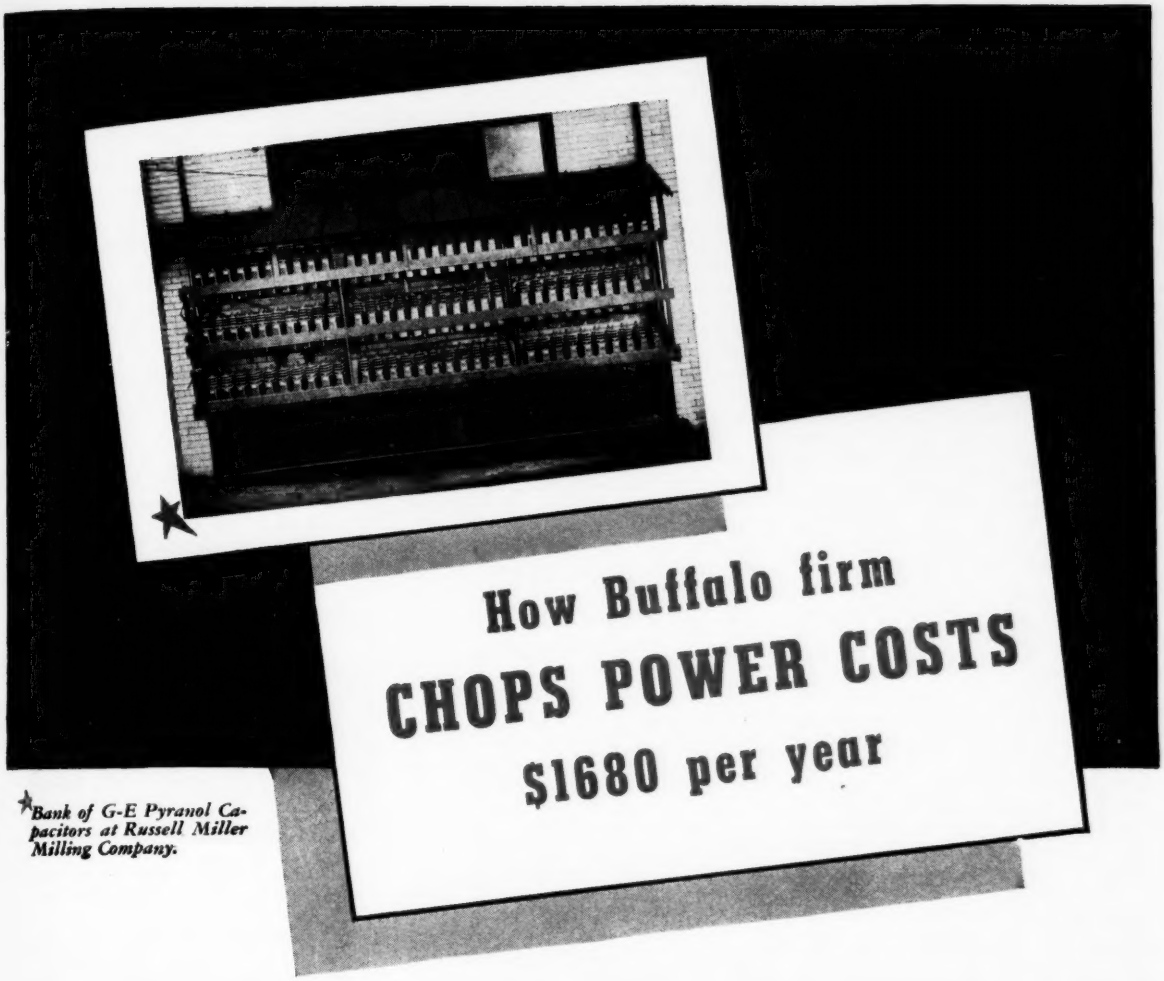


Fig. 2—right. Diagram showing how pressure vessels form parts of distillation system



How Buffalo firm CHOPS POWER COSTS $1680 per year

★*Bank of G-E Pyranol Capacitors at Russell Miller Milling Company.*

The Russell Miller Milling Company of Buffalo uses 1800 to 1900 electrical horsepower in handling flour, feed, and grain products. Induction motors supply most of the power and considerable reactive kva is drawn with a resulting plant power-factor of about 65 per cent.

Since the power company was required to supply this load having excessive KVAR content, there was a charge for the kilovars (reactive kva) as well as for the kilowatts—a penalty that cost the Russell Miller Milling Company approximately $1680 per year.

A bank of General Electric capacitors was installed. Here the Russell Miller Milling Company now produces kilovars on the spot, so to speak—with no fuel cost, no attendance, no maintenance. Power factor has been raised to better than 95 per cent. $1680 a year is saved.

Capacitors May Make Similar Savings For You

If you have a penalty clause in your power contract—power factor, kva or kilovar—capacitors can save you money. If you have circuits that are overloaded, or if you want to add to fully loaded circuits, capacitors often provide the answer —30% improvement is not unusual. Or if you are having troubles because of low voltage due to poor power factor, capacitors may be the answer.

In any of these cases, a General Electric sales engineer will be glad to work with you in determining whether capacitors can help you, and just how much they will save. Just call your G-E representative, or write *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

407-181

cylinders in the event that the discharge line were inadvertently closed?

2. Should not the safety valve on the receiver or pressure vessel be of sufficient capacity to prevent overpressure in the event the water on the condenser were inadvertently turned off?

3. Should not the gage device on the vessel, the safety valves, the drain valves, and all connected piping and appurtenances be given the same consideration as to the maximum allowable working pressure vessel itself when it was designed?

Let us consider a complete distillation system as shown in Fig. 2. With all valves open and the entire unit under normal operation is it not true that this consists of a complete pressure system and that the failure of any part of this system would create as much hazard as though the largest item itelf had failed?

In these simple examples we have assumed that the units were properly designed, installed, and operated within the mechanical limitations of the equipment involved and we know that the equipment must be maintained in good mechanical condition in order to realize continuity of production over a long period of time. One means of maintaining this mechanical perfection is through a procedure of periodic test and inspection and preventive maintenance instead of breakdown repair.

No matter has yet been found in nature or devised by man which will not rust, decay, or otherwise deteriorate when exposed to the elements. The insurance carriers were probably the first to recognize this fact. They learned by experience many years ago that mechanical failures must be prevented if they were to succeed financially, and they were the first to originate procedures for periodic test and inspection.

We might well take a lesson from them. Their procedures are simple. Their records are accurate. Through their records they are able so to base their insurance rate as to be economical to the insured and profitable to the carrier. Their right to cancel all or any part of their insurance coverage, to increase the premium rate in cases of negligent operation or lack of preventive maintenance, or to decrease the premium rate for good operation or good preventive maintenance, is the only authority they can exercise over industry. We cannot, however, consider this sufficient to ensure safe operating conditions.

Records indicate that the petroleum industry has definitely reduced mechanical failures by preventive maintenance through periodic test and inspection procedures, as have the airlines and railroads, all of whom have very enviable records of mechanical safety.

Design and Operation Often Well-Recorded

With many processes, especially those concerned with the manufacture of chemicals and new petroleum products, the hazards are greatly magnified by the fact that, in addition to the overall mechanical hazard involved, we have the chemical hazard as well, wherein flammable, toxic, and corrosive gases are added to the natural elements to form a much greater destructive force under abnormal operating conditions.

The information from the research department on through the process development is passed on to the operating group, that they may be guided by the data that were collected during the development of the particular processes. Analytical laboratories are established for the specific purpose of production control.

Also, the production engineer has a complete running record of his product, thus enabling him to compare it with the original specification and adjust his operation conditions (temperature, pressure, feed proportion) to make products of a definite specification. Further, this chemical record includes the operating log sheets which record pressure, temperature, etc., at periodic intervals. All of this goes to make up his chemical know-how.

Maintenance Not Recorded as Well as Design and Operation

The record of our mechanical phase, however, is not as complete. It is true that the maintenance department is also an integral part of the plant operation in the same sense as the analytical laboratory. However, mechanical operation is not recorded as extensively nor as completely as the chemical operation.

This statement is not intended as a reflection on the capabilities of maintenance engineers and mechanics. However, they are handicapped because they do not operate the equipment which they repair and they do not necessarily understand the chemical phase of the production line because the information is not passed on to them the way it is to the operators. By this same token the mechanical details that are encountered, if recorded at all, are very seldom passed back to the operating group. Under such a procedure, the mechanical phase of our operation is a mystery to the production man, and he is unable to correlate it with the chemical phase of the production line.

In order to operate efficiently, the complete history of the equipment, including the basis on which it was designed, the materials of construction, the maximum allowable working pressure, the factor of safety involved, the capacities, etc., should be a matter of record and be made available for quick reference to those men whose responsibility it is to operate the equipment.

Preventive Maintenance Should Be Part of Product Development

Let us follow through in outline the development of a new product, which usually originates through research, progressing to the process development stage and finally to the Engineering Department for the design of a commercial unit.

It is at this point perhaps that the nucleus of the record system should start. As a general rule, each item of equipment is identified by some numerical or alphabetical system and all information including the design specification, original test report, metallurgical analysis of the metals used in fabrication, etc., should be compiled and identified with each item of apparatus. This record system should be set up in such a way as to receive any additional information such as retest reports, inspections, corrosion rates, etc., that might occur during the entire life of the equipment. The pertinent information should be made with sufficient copies to supply operation, maintenance, and safety departments.

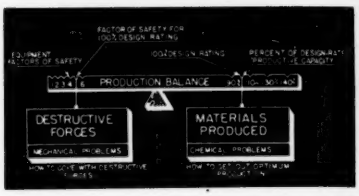


Fig. 3. Chart showing effect of overloading equipment for sake of more production

Such a program should include a preventive maintenance program for the control of destructive forces. This should be originated and carried along with the program that is formulated for the control of the productive forces. In other words, it is easier to keep out of trouble than to get out of trouble. Destructive forces should be tabulated. They are usually well known but often disregarded.

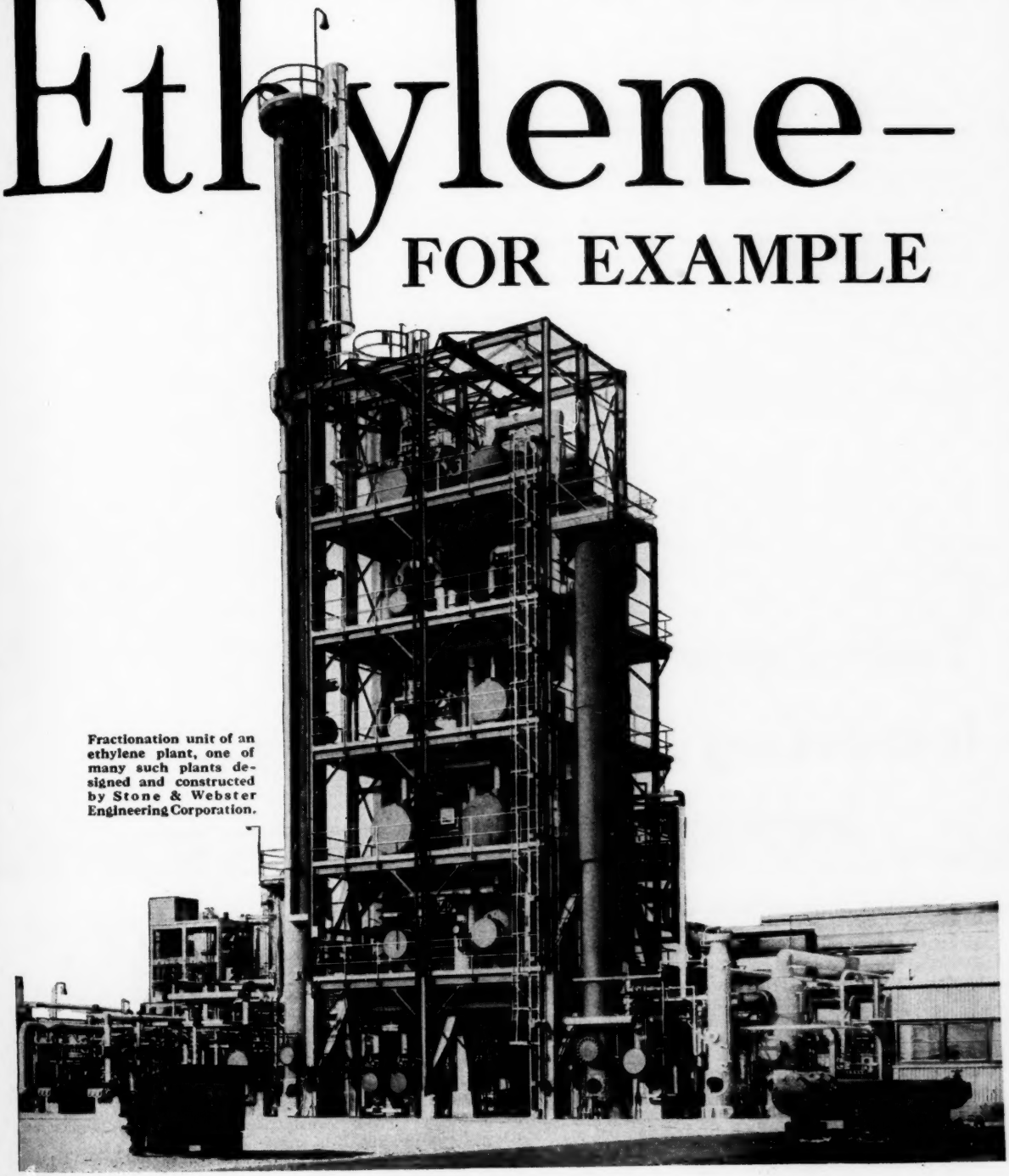
Our assignment must be based on a

DON'T FORGET - FACTOR OF SAFETY IS ALWAYS ON DOWNWARD TREND UNLESS YOU CHECK IT.
FACTOR OF SAFETY TO ALLOW FOR UNKNOWN IN DESIGN, FABRICATION AND MATERIAL IMPERFECTIONS
OPERATIONS BEGIN - SMUG FEELING OF PLENTY OF FACTOR OF SAFETY EVERYWHERE (CERTIFIED BY OWN INSPECTION OR DEPENDENCE UPON MFR'S RELIABILITY)
EFFECT OF PLANNED PERIODIC TEST & INSPECTION PROGRAM
EFFECT OF SUDDEN DESTRUCTIVE FORCE SUCH AS EXPLOSION OR SERIOUS OPERATOR ABUSE
FACTS FROM RECORDS
EFFECT OF NORMAL DESTRUCTIVE FORCES SUCH AS WEAR-CORROSION-FATIGUE (FAILURE TO PLAN INSPECTION AND OVERHAUL)
EFFECT OF MISTAKE IN DESIGN, FABRICATION, ETC., INADEQUATE INSPECTION (INSUFFICIENT FACTOR OF SAFETY AT START TO COPE WITH NORMAL DESTRUCTIVE FORCES)
LAST CHANCE FOR PREVENTIVE MAINTENANCE HERE
UNEXPECTED EQUIPMENT FAILURE AT ZERO FACTOR OF SAFETY
PERIOD OF USEFUL OPERATION
PERIOD OF LOST PRODUCTION IF NO SPARE

Fig. 4. Diagram showing how preventive maintenance program guards against zero factor of safety

Ethylene—

FOR EXAMPLE



Fractionation unit of an ethylene plant, one of many such plants designed and constructed by Stone & Webster Engineering Corporation.

Over a half century of broad experience qualifies our organization to assume full responsibility for all phases of design, engineering and construction of projects in the petroleum and chemical industries.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY OF STONE & WEBSTER, INC.

cooperative effort, as it is not necessarily the function of any single department or individual. A primary requirement is an effective plant-wide employee training program for operators, maintenance repairmen, inspectors, engineers, and supervisors.

The well-informed supervisor realizes that mechanical and safety features, as well as production features, cannot be achieved by orders alone. It must be instilled into the mind and work method of the employee. This can be accomplished only through knowledge of the basic requirement involved. This knowledge can be imparted to others only through a planned educational program based on experience.

"Production balance" is a requirement often overlooked, and by "production balance" is meant the balance between destructive forces or the mechanical problem against the material produced or the chemical problem. See Fig. 3.

The effect of overloading equipment for the sake of more production often is to create a hazard, unless very definite consideration is given to the limitations of the equipment involved, because the increase in production may decrease the resistance of the equipment involved to the destructive forces involved.

Factors of Safety—or Ignorance

As a general rule all equipment is designed with a factor of safety of 5. What is this factor of safety, which is sometimes called a factor of ignorance? Basically, it is additional strength, additional metal in the walls of a pressure vessel that is intended to allow for the unknown in design, fabrication and material imperfection. The factor of safety is there only as long as the destructive forces are not active.

A new piece of equipment is usually placed in operation with a smug feeling of security. The operators look upon it as a beautiful piece of equipment, a mechanical miracle, which will relieve them of considerable manual labor. It should be emphasized that deterioration, normal wear and tear, corrosion, fatigue, etc., start the day the equipment is placed in service, and, unless operated properly within the maximum allowable working conditions, the most perfectly designed and built equipment in the world can become obsolete through deterioration in a very short period of time. On the other hand, if operated properly within the design limitation and properly maintained, it may last indefinitely. See Fig. 4.

Obviously, we cannot expect our inspectors and operators to know and remember all the details of design, installation, etc. They should, however, be definitely familiar with fundamentals. The specific detail can and should be a part of the complete record system set up in such a way as to give easy and quick reference to each item by all interested personnel.

Any problem or procedure will be only as successful as the degree of control kept on it. For instance

1. Control requires record.
2. Record requires cooperation.
3. Cooperation requires knowledge of requirements.
4. Requirements are based on experience.

Our codes and procedures give us security only so long as they apply to, and fulfill our production requirements. Progress is being made every day, codes and procedures must be changed continuously to keep up with our progress. This however takes time, changes can only be based on sound experience. Therefore we must take chances, and by virtue of this fact our codes are always from 5 to 10 years behind practice.

Technique for Insulating Boiler Headers

Easily applied mineral wool cement used as heat insulation on water tube boiler headers is effective fuel saver . . . Calculation of savings outlined . . . Directions for use

ONE VERY important source of steam boiler heat loss is the boiler header. Boiler headers of the type studded with safety hand-hole covers present extremely irregular surfaces which at first glance seem difficult to insulate. Further, it is erroneously often thought that maintenance crews cannot get at hand-hole covers quickly and easily if they are covered by insulation.

Neither factor, however, need preclude simple and effective protection from heat loss.

The technique herein described involves the use of a mineral wool cement which can be applied so as to fill the recesses of each hand-hold cover, can be smoothed freely over the flange projection of each hand-hole cap, and can be built up to whatever thickness is most economical. When it becomes necessary to knock out any one or group of covers, it is a simple matter to break away the insulation in the vicinity, save it, and reapply the selfsame cement after the cap is replaced. Since the mineral wool cements are not chemically or physically changed in any way by wetting, trowel application and drying, they may be reused time and time again.

The extreme importance of insulating boiler headers with numerous hand-hole covers becomes apparent when it is realized that the true radiation area of such a header is generally between 2 and 3 times the apparent area. The average safety-hole cap is 3 in. in diameter by 2 in. deep, and they are spaced only 1½ in. apart. One calculation on a moderate size boiler header with a nominal area of 12 sq ft, revealed a true radiation surface of 30 sq ft.

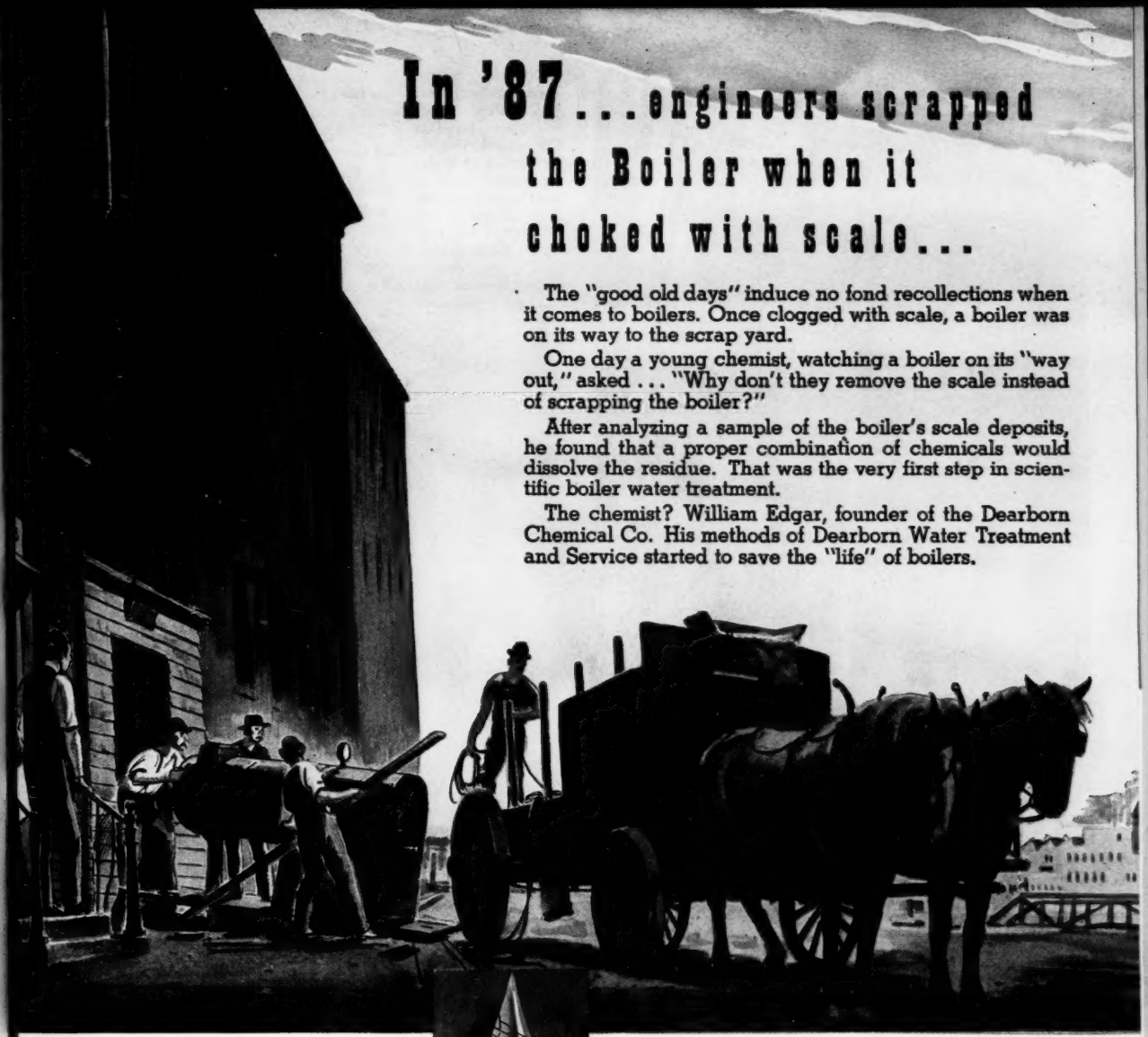
As an example, consider a boiler with an average header temperature of 400 F, which, accordingly, would have an uninsulated radiation loss of approximately 1000 Btu hr/sq ft. When insulated with 2 in. of mineral wool cement, this heat loss would be reduced to approximately 80 Btu hr/sq ft—a heat conservation of some 920 Btu hr/sq ft. Over the 30 sq ft true radiation surface of the above-considered 3 ft by 4 ft header, the total heat conservation would be 27,600 Btu hr. Considering coal at $5.00 per ton, the approximate annual savings effected by the insulation would be

$$\frac{27{,}600 \text{ Btu} \times 8{,}760 \text{ hr} \times \$5}{13{,}000 \text{ Btu/lb} \times 2000 \text{ lb} \times 60\%} = \$71.09$$

This $71 is equivalent to over 14 tons of coal.

Since the cost of the insulation of such a boiler head would never exceed $40, it is obvious that the insulation would pay for itself within 7 months of operation.

The application problem is simple. The cement is mixed with water (12 gal to each 50-lb bag)—to the degree that a small amount of liquid can ooze through the fingers when a quantity of the paste is clutched in the hand. Application is by simply spotting (throwing on by hand) a sufficient quantity to trowel to a thickness of ¾ to 1 in. After the first coat is dry, the process is repeated until the desired thickness is achieved. Adhesion to steel will exceed 3 psi, the cement will withstand temperatures up to 1500 F with no



In '87... engineers scrapped the Boiler when it choked with scale...

The "good old days" induce no fond recollections when it comes to boilers. Once clogged with scale, a boiler was on its way to the scrap yard.

One day a young chemist, watching a boiler on its "way out," asked . . . "Why don't they remove the scale instead of scrapping the boiler?"

After analyzing a sample of the boiler's scale deposits, he found that a proper combination of chemicals would dissolve the residue. That was the very first step in scientific boiler water treatment.

The chemist? William Edgar, founder of the Dearborn Chemical Co. His methods of Dearborn Water Treatment and Service started to save the "life" of boilers.

. . . in '47 engineers get rid of the Scale and save the Boiler!

Walk through Dearborn Laboratories today and it is hard to realize that dissolving residue in boilers with chemicals was once a "pioneer" idea. Saving the boiler is now a vast scientific procedure.

Bad-acting water samples from all parts of the country pour in for analysis under Dearborn scientific technique. Plant operating conditions are surveyed; corrective treatment programs mapped out; proper feeding equipment is installed. The boiler of today, thanks to Dearborn, is assured of its full quota of boiler-years . . . free from scale, corrosion, any water-hazard that hampers the efficient production of clean steam.

ESTABLISHED IN '87 — NEW HORIZONS IN '47

Dearborn

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ENGINEERING SERVICE AND WATER TREATMENT

Dearborn Chemical Company
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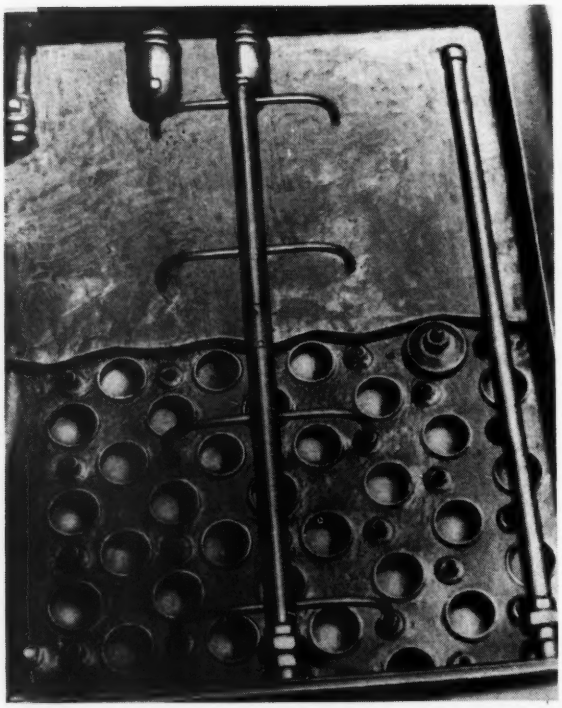
New York, Los Angeles, Toronto



Typical boiler header with safety hand-hole covers spaced on 4½-in. centers, showing method of applying mineral wool cement to thickness of 2 in. so that it fills all recesses and covers all minor protrusions. At header temperature of 400 F, such treatment reduces heat loss to 80 Btu-hr-sq ft

physical or chemical change, and 100 lb of dry cement should cover not less than 45 sq ft to a thickness of 1 in.

Because of the relatively long fiber of mineral wool insulations, it is possible cleanly to withdraw patches of the cement for boiler maintenance and inspection at any point. After the hand-hole covers are replaced, it is merely necessary to crumble up and reapply the cement as though it were new material.

In view of the very wide usage of small and medium size boilers thus studded with safety hand-hole caps the great potential fuel savings in boiler header insulation is apparent. It is believed by the Industrial Mineral Wool Institute, which supplied the above data, that greatest opportunity for taking advantage of the technique described will be found in the numerous plants where small and medium size steam generating units are common but not favored with too much advanced steam plant practice.

HOW HIGH IS HIGH PRESSURE?

(Editorial Comment)

IN POWER ENGINEERING we refer to 1250 psi as high pressure. We have only one power plant in the country at present operating commercially at a design pressure as high as 2300 psi. The critical pressure of steam—the pressure at which the specific volumes of steam and water are equal and it would be impossible to distinguish a water level in a steam drum—is approximately 3200 psi. Trying to be elegant—we even speak of such pressures as "elevated" pressures.

But these pressures are low, compared to those used in certain industrial processes, and are absolutely insignificant when compared with the pressures that have been investigated by the famous Percy W. Bridgman, Professor of Physics at Harvard University, in his research into high pressure.

As everybody should know by this time, particularly engineers, it was primarily for this work that Dr. Bridgman was awarded the Nobel prize in physics in 1946.

If you want to talk about really high pressure, consider the pressure at the center of the earth—almost 3,500,000 atmospheres or approximately 50,000,000 psi. Dr. Bridgman has not produced any such pressure as that but he *has* produced, in his laboratory, pressures of a little over 400,000 atmospheres or approximately 6,000,000 psi. Actually, little can be done with such a pressure except to attain it and record it. But at pressures of 100,000 atmospheres, about 750 tons per square inch or 1,500,000 psi, he has been able to make measurements enough to be significant; and he has demonstrated a wealth of new and interesting effects found at still lower pressures.

To produce these tremendous pressures, the apparatus used a fluid medium to transmit pressure, following in general the principle of the hydraulic ram. To prevent leakage, special designs of packing were developed in which the pressure itself automatically tightens the packing. For vessels strong enough to hold such tremendous pressures, alloy steels must be used, such as carboloy. The strength of the vessel can also be raised by improving its structural shape. It is possible, by suitable design, to make the pressure itself automatically support the vessel, especially by employing a sort of cascade effect.

Now, what is the importance of all this work at high pressures? It is very important; for by means of it we learn a great deal about the structure of matter itself. Water, metals and many other ordinary substances are usually described as incompressible. Yet pressures have been reached in the laboratory that actually reduce water to ½ its original volume, while the same pressure reduced iron in volume by only 5 per cent .

Pressure not only changes the volume but also the temperature at which the substance melts. Mercury is liquid under ordinary conditions, freezes at —40 degrees; but, when squeezed at 12,000 atmospheres, mercury freezes at room temperature.

Water is an exception to many of the rules, for water expands when it freezes. When the pressure is raised, the freezing temperature of water goes down instead of up. Thus the freezing temperature of water can be progressively lowered from the familiar 32 F to —8 F at 2000 atmospheres or approximately 30,000 psi.

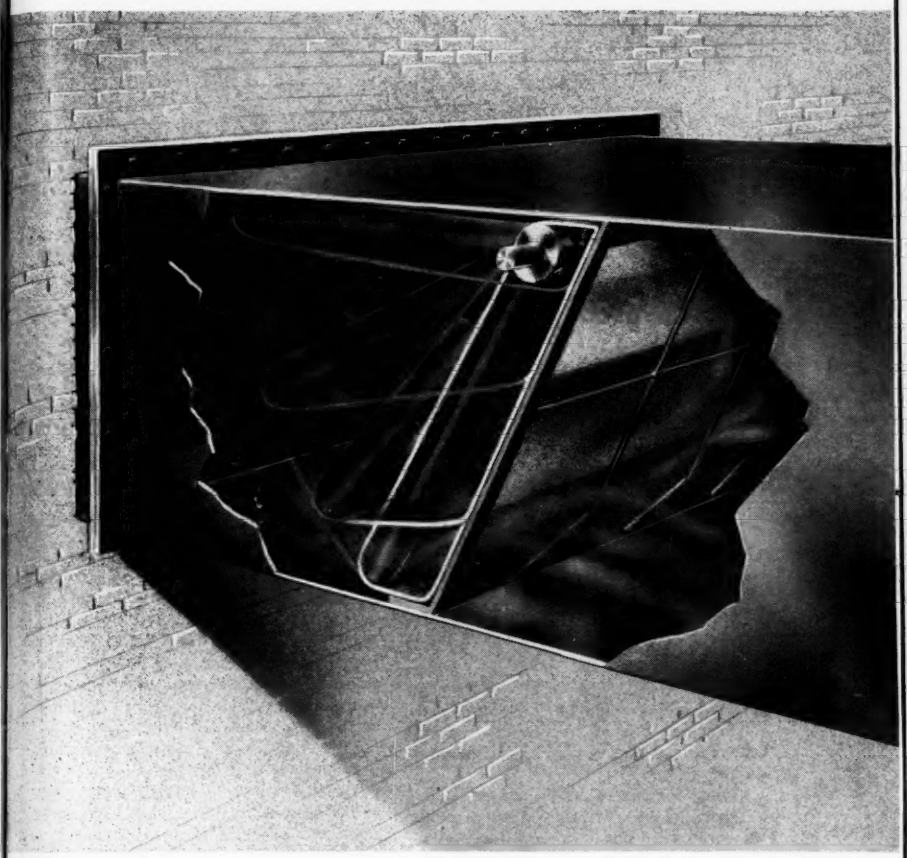
At that pressure the ice gives up its struggle, collapses into a new kind of ice that is denser than water instead of lighter. Hence the melting point rises when increased pressure is imposed but this new kind of ice also gives up the struggle presently, and is replaced by another. In all, six new kinds of ice are known, all produced by high pressure. One of them, at a pressure of 40,000 atmospheres, melts at the temperature of melting solder.

Other substances can be forced by pressure to take new solid forms. Under pressure, camphor may occur in 11 different forms. Important characteristics like viscosity and plasticity are studied. The behavior of steel, under a pressure of 20,000 atmospheres, stretched out to 300 times its initial length, is a study in ductility.

So if you are really interested in the phenomena of high pressure, get The Physics of High Pressure by Dr. Bridgman, or some of his other books, and read about pressures that are really "elevated."—C.R.E.

USE OF ALLOY cast iron parts that get rough usage in power plant equipment is interestingly described and illustrated in an article Power Costs Trimmed as Abrasion Takes a Licking in *Inco*, Vol. 20, No. 4. This shows how such parts as ash pump impellers, crusher plates, discs and seats of gate valves, ash conveyor lines, pulverizer parts, etc. can be designed and fabricated to use this material for reducing wear. There is an interesting table of wear resistance for various types of power plant equipment.

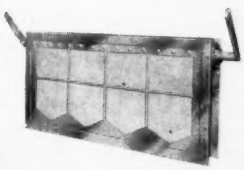
Leaf Type HEACON DAMPERS



give more accurate control . . . reduce heat losses due to leakage

Where two boilers are served by one Stack and only one is normally in operation, type LH, Heacon dampers, have been highly successful as boiler outlet dampers.

On the type LH, the asbestos curtain is held on the damper seals by the draft when closed and is peeled off, illustrated above, as the frame is rotated. Bottom seal is V-ported, permitting improved flow characteristic and more accurate control of the small flows. The following advantages are realized:



1. Leakage from the idle boiler is prevented and the entire stack capacity is available to the active boiler.

2. During nightly and weekend banking periods heat is retained in the boiler that would escape to the stack through a conventional damper.

3. Accurate control of the gas flow from the boiler increases range of output and improves efficiency during operating periods.

Our project engineers will be glad to cooperate with you in making these advantages available to your plant.

FIELD PROJECT ENGINEERS:

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Bona Allen Bldg.

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Thermix Engineering Co.
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1200 Niagara Street

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1408 Independence Bldg.

CHATTANOOGA 2, TENN.
Edgar A. Rogers
Chattanooga Bank Bldg.

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HEACON

THE THERMIX CORPORATION

FIRST NATIONAL BANK BLDG. **GREENWICH, CONNECTICUT**

PLACING THE STEAM GENERATOR IN OPERATION

(*Continued from page 82*)

boiler operator is eating and the service engineer finds a partially cold dinner awaiting his immediate attention. The food makes him sleepy and he spends some time just sitting with his back against the warm forced air duct to the burners. Operation is proceeding smoothly and everything has a normal sound and he is perfectly relaxed and his thoughts wander idly from speculation as to how much sleep he will get during the coming night, to other thoughts which are of no concern to anyone interested only in boilers.

Sometime later he secures enough ambition to make a hurried inspection trip over the boiler unit and then he spends some time watching the results crew as they check and adjust pressure gages, temperature recorders, flowmeters and controllers on the operating panel. He makes the final adjustments to the two pulverizer feeder controllers and does some checking to make sure that the weights of coal being fed are correct. Along towards evening he calls the load dispatcher and tells him that he can reduce the load if he desires as the pulverizer feeder controller settings are complete. The load dispatcher has a dozen reasons for wanting to maintain the load and the service engineer finally agrees to continue the operation of two pulverizers and to hold the load as it is. He turns away from the phone in disgust and wonders if all load dispatchers are the same. Invariably when the load is increased on a new unit the load dispatcher seems unable to do without the extra block of load from that time on. It may be listed as unstable load on his book but when the load has been made available even such a notation seems to mean little to a load dispatcher. Actually there is no valid reason for reducing load but the argument has at least given the service engineer a new interest in life. Tomorrow the load dispatcher will probably be calling asking him to increase load and he looks forward to telling the so and so where to get off at. He knows that tomorrow the load will probably be increased and he looks forward to having the new unit under maximum load in the next 2 or 3 days but he would never admit this knowledge to the load dispatcher as all the fun in arguing would be gone.

Along towards evening the erection crews quit work and as he sees them leaving the plant, he begins to wonder where his relief is. The relief service engineer soon appears and he asks him to check the coal feeders and to inspect the expansion joints during the night. He also asks him to adjust the prisms on the water columns to give a more distinct image of the water level in the mirrors and to secure a set of thermocouple temperature readings for their records. Plant officials are visiting the boiler operating board and after talking to them he finds that most of them are planning to go home for dinner. By 6:00 p m there is a list of telephone numbers in the log book and the plant officials have all disappeared and the operating crews are on their own. The service engineer finds the turbine service engineer dozing while his relief engineer is trying to find out what is holding up the oil to one of the exciter bearings. The turbine engineer suffers a rude awakening and after a few warm words with the boiler service engineer, he agrees to toss coins to determine who will buy the dinners. Evidently the prospect of a free dinner mollifies the turbine engineers opinion of the boiler service engineer because they leave the plant in a few minutes evidently the best of friends.

Operation proceeds smoothly and the operators have very little to do except to stay awake. The boiler operator tries various adjustments on the burners as this helps to relieve the monotony. After a number of adjustments the operator decides that the best burner results are being obtained. The service engineer notes these changes when he returns later that evening. Combustion is excellent and an orsat check reveals that the excess air is the desired range. The service engineer knows that no two men will operate exactly alike and he simply tells the operator to continue to experiment with the burner adjustments until he is satisfied that the best possible combustion results are being obtained.

During the evening the third and final pulverizer is placed in service. The problem of changing pulverizers is handled by the operator and he swings load from one pulverizer to the other and removes a pulverizer from service without any difficulty except for a word of caution from the service engineer that an oil torch should be used to light off each additional burner. The coal feeder on the third pulverizer is adjusted and checked and by midnight this work has been completed. One of the bearings on the primary air fan for the third pulverizer is running hot but after some discussion it is decided to continue the operation of this unit to determine if the new bearing is going to be satisfactory after an initial period of running-in has been completed. The service engineer then leaves the plant to secure a few hours sleep as he feels that operation should continue in a normal manner until the following morning.

(To be continued)

RESPONSIBILITIES OF BUSINESS PAPERS

(*Continued from page 67*)

is not solely a matter of concern to Americans; it is of paramount importance to most of the two billion persons on this globe.

Role of Business Papers in Post War Era

This new role of our nation in postwar world affairs is an unprecedented challenge to American business and as such it automatically imposes new responsibilities upon the business press. The biggest problem confronting business in the postwar period is to make the American economic system a more reliable and stable agency of well-being for the greatest number of people. To help business solve this problem is the new No. 1 assignment of American business papers.

The importance of this assignment can be made clear if we will consider present world trends. As recently as last Nov. 5 the people of the United States demonstrated their desire to move toward the right. People in other nations, with few exceptions, continue to drift toward the left. These trends accentuate the fact that the great issue of the near future will be the rivalry between the American system and the numerous forms of statism embraced or sought by most other nations.

Statism has not proved itself convincingly anywhere, yet hundreds of millions of the world's people toy with it tentatively in the hope that it will provide at least a minimum of security. If they cannot have security and freedom together, in desperation they will take security alone. It stands to reason that if we demonstrate that our system can be freed from the devastating fluctuations of an erratic business cycle, we can swing most of the world's two billion people from their desperate pursuit of elusive ideologies to greater confidence in the American system.

This is the logical new responsibility of the business press to society. Having paced American business to high achievements in material advancement, we now face the task of pacing it to new achievements in its service to society.

A NEW PLASTIC anti-friction pulley for maintaining uniform tension on tapes which drive cotton spindles has been announced by SKF Industries, Inc. It is claimed that the new pulley reduces down time caused by tape slipping from dragging pulleys and saves power because of its light weight. The new anti-friction pulley consists of a medium impact phenolic housing molded around a deep groove steel ball bearing.

A NEW oil burner head for gun type burners makes possible perfect combustion using only 5 to 10 per cent excess air instead of the usual 150 per cent, according to an announcement made by the Shell Oil Co. It is also claimed that the new burner head will make possible a fuel saving up to 20 per cent. In the new head, a secondary air supply is blown into the injected cone of oil which is burning with the primary air supply. No changes have been made in the design of the nozzle, which is that used on the conventional high pressure gun type burner.

Scientific Metal Distribution

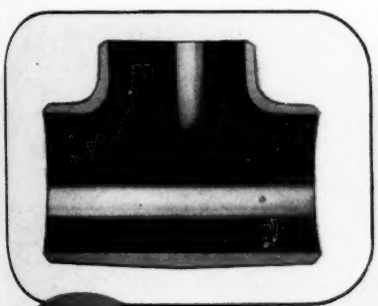
(Based on Strain Measurements)

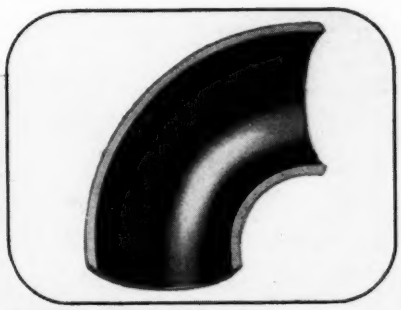
ASSURES DEPENDABLE SERVICE FROM LADISH SEAMLESS WELDING FITTINGS

Scientific distribution of metal in the wall sections of Ladish Seamless Welding Fittings accounts in large measure for their high dynamic strength and dependability. Under the Ladish forming process, high quality steel tubing is worked under compression at forging temperatures wherein the flow of hot, plastic metal is controlled to provide desired cross section thickness at all points.

In Ladish Tees this permits concentration of additional metal at points of greatest stress — crotch, sides and bottom of run — yet tapers the fitting to nominal pipe size at all outlets. In Ladish Ells and Returns the flow of metal is controlled to produce uniform wall thickness.

Smooth inner surfaces, full effective radii, unrestricted circularity, geometric accuracy, permanent identification and heat code protection . . . these are additional features that assure long service when you "call your Ladish distributor for CONTROLLED QUALITY Seamless Welding Fittings."





◀ Section view at left illustrates how scientific metal distribution provides maximum strength at crotch and at sides and bottom of run.

◀ This cutaway illustration shows the uniform wall thickness achieved in Ladish Ells and Returns.

FREE

SEND TODAY FOR THIS DIMENSIONAL DATA FOLDER

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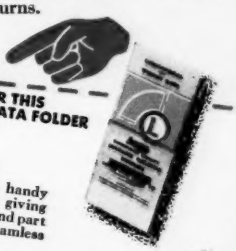
Dept. PP-5
Cudahy, Wisconsin

Please send me the handy 10-page data folder giving dimensions, weights and part number of Ladish Seamless Welding Fittings.

Name .....
Title .....
Company .....
Address .....
City ..... Zone ..... State .....



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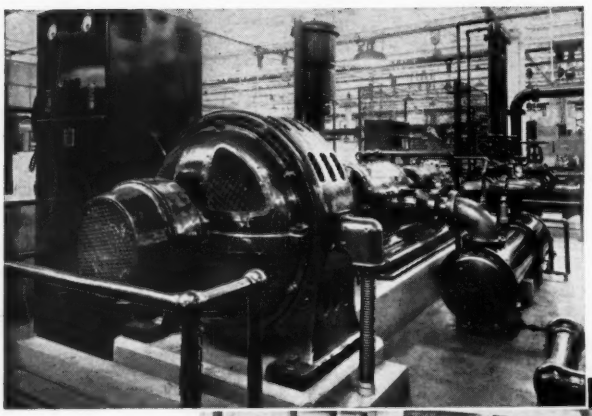

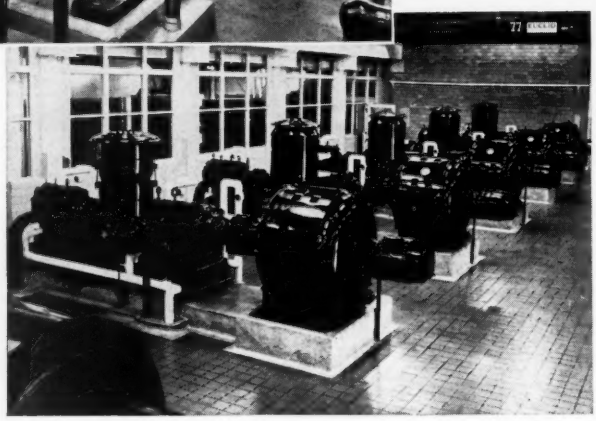

43

Fuller Rotary Compressors Purchased Since 1939

Starting in 1939, one of the largest manufacturing companies of the country purchased its first Fuller Rotary Compressor. Satisfactory performance of the initial installation has led to many additional orders. Up to the present time, 43 Fuller Rotaries have been purchased and installed by the customer in its many plants throughout the country.

The majority of machines installed in these plants are of the two-stage type, operating at 125-lb. pressure, such as illustrated above.

These machines will serve for many years to come because, they're built for long, continous service . . . few working parts, none to adjust. In addition, due to design and construction, a Fuller Rotary maintains its original capacity for the life of the machine.

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FULLER-KINYON, FULLER-FLUXO AND THE AIRVEYOR CONVEYING SYSTEMS . . . ROTARY FEEDERS AND DISCHARGE GATES . . . ROTARY AIR COMPRESSORS AND VACUUM PUMPS . . . AIR QUENCHING INCLINED GRATE COOLERS . . . DRY PULVERIZED-MATERIAL COOLER . . . AERATION UNITS . . . MATERIAL-LEVEL INDICATORS . . . MOTION SAFETY SWITCH . . . SLURRY VALVES . . . SAMPLERS

C-149

COMING EVENTS

Society for Experimental Stress Analysis—Annual meeting of the SESA; to be held May 15 through 17, with headquarters at the Hotel Stevens, Chicago.

American Society of Lubrication Engineers—Second annual convention of the ASLE; to be held May 17 through 19, with headquarters at the Hotel William Penn in Pittsburgh.

Oil and Gas Power Division of ASME—The 19th Annual Conference of the Oil and Gas Power Division of the ASME; to be held in Cleveland, May 21 through 24, with headquarters at the Hotel Statler.

ASHVE—Semi-Annual meeting of the American Society of Heating & Ventilating Engineers; to be held June 2 through 4 in Coronado, California with headquarters at the Hotel del Coronado.

AIEE—Summer General Meeting of the American Institute of Electrical Engineers; to be held in Montreal, Quebec, Can., June 9 through 13.

Stoker Manufacturers—Annual meeting of the Stoker Manufacturers' Association to be held June 16, 17 and 18; headquarters to be at Lookout Mountain Hotel, Lookout Mountain, Tenn.

ASME—Semi-Annual Meeting of the American Society of Mechanical Engineers; to be held in Chicago, June 16 through 19, with headquarters at the Hotel Stevens.

National District Heating Association—38th Annual Meeting of the NDHA; to be held June 16 through 19 with headquarters at the Ambassador Hotel, Atlantic City, N.J.

ASTM—1947 Annual Meeting; to be held in Atlantic City, June 16 through 20, with headquarters at Chalfonte-Haddon Hall.

ASME—Fall Meeting of American Society of Mechanical Engineers; to be held in Salt Lake City, September 1 through 4, with headquarters at the Hotel Utah.

NAPE—National Association of Power Engineers, Annual Show and Convention; to be held August 25 through 28 with headquarters at Hotel Statler.

Instrument Society—Instrument Society of America annual meeting; to be held the week of September 8, 1947, with headquarters at the Stevens Hotel, Chicago.

Instrumentation Conference—Instrumentation Conference and Exhibit for 1947; to be held the week of September 8, with headquarters at the Stevens Hotel, Chicago.

ASME—Fuels Division Meeting of the American Society of Mechanical Engineers; to be held, October 6 through 8, in Houston, Texas. (Headquarters not yet announced.)

Hydraulics—Third Annual Meeting of the National Conference on Industrial Hydraulics (formerly the Hydraulic Machinery Conference); to be held October 16 and 17 in Chicago with headquarters at the Hotel Continental.

Power Exposition—Midwest Engineering and Power Exposition, "The Chicago Power Show," to be held November 15 through 20 at the Chicago Coliseum.

ASME—Annual Meeting of the American Society of Mechanical Engineers; to be held in either New York City or Atlantic City, N.J., December 2 through 5. Headquarters Chalfonte-Haddon Hall.

Refrigeration and Air Conditioning Exposition—Fifth All-Industry Exposition; to be held January 26 through 29, 1948 with headquarters at Cleveland Public Auditorium, Cleveland, Ohio.

PROPELLER FAN ASSN. OFFICERS

At the Eighth Annual Meeting of the Propeller Fan Manufacturers' Association held at New Orleans, February 6-7, 1947, the following officers were elected for the ensuing year: W. J. Lohman, Jr., President; M. L. Aitken, Vice-President; L. O. Monroe, Secretary-Treasurer.

Mr. Lohman, Jr., is Treasurer of Chelsea Products, Inc., Irvington, N.J., and Mr. Aitken is General Manager of Propellair, Inc., Springfield, Ohio.

Mystic Maze

(*Isotherm Adsorption Apparatus*)

Seen through this mystic maze of tubes and wiring is a Sinclair Research technician. What his apparatus means to users of industrial lubricants is no mystery, however.

At Sinclair Laboratories, the Isotherm Adsorption Apparatus is used constantly to determine the effectiveness of adsorbents used in lubricating oil refining procedures. Because Sinclair lubricants are made with infinite care to suit the specific requirements of your equipment, it is highly important to know exactly how adsorbents, catalysts, and other treating materials perform in a refining process.

This intricate apparatus is an assurance that Sinclair lubricant manufacture guarantees the very highest quality product. It is one more evidence of the painstaking Sinclair research and refinery control that result in outstanding lubricant performance.

Sinclair Power Plant Oils

For Turbines:

SINTURLITE OILS

Oxidation stability, rust prevention, long life

For Compressors:

RUBILENE OILS

In grades to suit all operating conditions

From selected crude processed to quality finish

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Lubricants for Industry

FINEST CRUDES + EXPERT RESEARCH and MANUFACTURING CONTROL = OUTSTANDING PERFORMANCE

We Didn't Want to Make Strainers

BUT we needed them for use with Yarway Steam Equipment and couldn't find any to suit us.

So we designed the *YARWAY Strainer.* Apparently a lot of other people were having "Strainer trouble" because the Yarway Strainers *purchased* in a few years now number *many thousands.*

Why don't you look into this better Strainer for your money? Buy one from your supply house (over 100 Mill Supply Houses now have them).

Cadmium Plated for protection against corrosion and for better appearance.

Examine its *high grade Monel woven wire screen* that stops dirt—lets condensate or other fluids flow freely.

Notice the removable blow-off bushing. Screen and bushing come out together—go back together, *automatically aligning.*

Six standard sizes from ½" to 2" for pressures to 600 lb.

See your Mill Supply House or write for Bulletin S-201

YARNALL-WARING COMPANY
114 Mermaid Ave. PHILADELPHIA 18, PA.

YARWAY STRAINERS

NEWS *from* THE FIELD

HEATING AND VENTILATING EXPOSITION REVEALS ADVANCES

MANY ADVANCES in practice were revealed by new equipment shown at the 7th International Heating and Ventilating Exposition, held in Cleveland's Lakeside Hall, January 27th to 31st, inclusive. Many significant innovations were featured, but this first postwar exposition as a whole was comprehensive and well balanced, representing the products of a highly diversified industrial group with strongly progressive tendencies. Visitors registered during the week numbered 30,561.

Like its predecessors, the Exposition was held under the auspices of the American Society of Heating and Ventilating Engineers, and in conjunction with its 53rd annual meeting, during which the new research laboratory was formally dedicated in the Society's own building in Cleveland and a comprehensive technical program for the coming year affirmed. The National Warm Air Heating and Air Conditioning Association also held its annual meeting during the period of the Exposition.

In recognition of the large number of new types of equipment now being completed and made ready for the next showing, as well as the fact that the Exposition furnishes the greatest opportunity for making contacts with every phase of industry, the Council of the Society, meeting during the week, decided that the next meetings of the Society, and the 8th International Heating and Ventilating Exposition be held annually through 1950.

MIDWEST STOKER ASSN. OFFICERS

ALL INCUMBENT officers of the Midwest Stoker Association were re-elected at the Annual Meeting held recently at the Builders Club in Chicago. The officers are: President, Joseph G. Beard, Assistant Manager, Stoker Division, Illinois Iron and Bolt Co.; Vice President, F. J. Moran, Sales Manager, C. E. Sundberg Co.; and Secretary-Treasurer, E. W. Jones, Office Manager, Chicago Branch, Iron Fireman Manufacturing Co.

The above officers were also re-elected to the Association's Board of Directors and in addition the following members were elected to the Board: J. J. Hayes, Manager, Auburn Stoker Co. and L. W. Walquist, Chicago.

HIGH EXPENDITURES FOR NEW STEEL EQUIPMENT

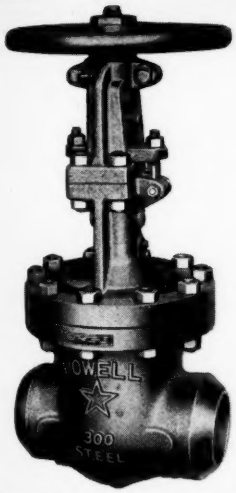
STEEL companies plan to spend a record amount, $448,000,000, in 1947 for new equipment and additional facilities required to satisfy current steel demands, according to a survey by the American Iron and Steel Institute. This represents a 54 per cent gain over 1946 expenditures of $291,000,000 out of a total original appropriation of $327,000,000. A portion of the 1947 funds represents a carry-over from 1946, when strikes and shortages of materials delayed the delivery of much equipment which the steel industry had expected to install.

The 1947 appropriation brings to two and three-quarter billions the total amount spent by steel companies over the past twelve years in their programs to expand and improve their plants. From 1936 through 1946 such annual expenditures by the industry have averaged more than $200,000,000 per year.

BOILER CODE REVISION HEARINGS

THE BOILER CODE Committee of The American Society of Mechanical Engineers has announced dates for two public hearings to be held in the Southwest on the proposed revision of Section VIII of the ASME Boiler Construction Code (Unfired Pressure Vessel

depends on *perfect* control.



Class 300-pound Cast Steel Gate Valve with welding ends, bolted flanged yoke, outside screw rising stem and taper wedge solid disc.

Large Iron Body Bronze Mounted Gate Valve for 125 pounds W.S.P. made in sizes 2" to 30", incl. Has flanged ends, outside screw rising stem, bolted flanged yoke and taper wedge solid disc. Taper wedge double discs can be provided in sizes 2" to 12", incl. Also available in All Iron for process lines.

Small size 200-pound Bronze Globe Valve for steam, water, oil or gas. For assured, long-life performance, it has a renewable, specially heat treated stainless steel seat and regrindable, renewable, wear-resisting "Powellium" nickel-bronze, plug type disc.

The performance of an orchestra depends on the control exercised by the conductor. Without this control, the greatest aggregation of musicians in the world would make a sorry mess of the finest symphony.

Likewise, the smooth performance of an industrial plant depends on the valves which control the media necessary to its operation. And for perfect performance in flow control, the valves must be adapted in every way to the conditions under which they operate.

For more than a century, Powell Engineers have been designing valves to meet every new flow control condition as it has arisen.

Today there's a Powell Valve for every known requirement of the modern power plant. Bronze and Iron Valves of all types are available for low pressure steam, water, oil and gas lines. And for the higher pressures and temperatures, Powell offers a most complete line of Cast Steel Valves of all types —Globe, Angle, Gate, Check and Non-return— from Class 150 pounds to Class 2500 pounds, inclusive. When desirable, Powell Cast Steel Valves can be equipped for gear, toggle or motor operation.

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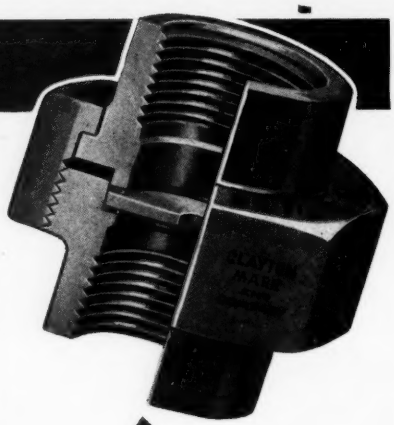
DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

POWELL VALVES

ORIFICE
FORGED STEEL UNIONS

Orifice

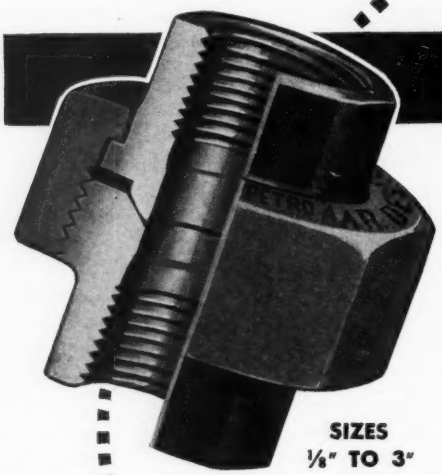


A SIMPLE, EASY-TO-HANDLE, MODERATELY PRICED, ORIFICE UNION.

Ideal for flow control of Steam, Oil, Ammonia, Water, Gas and Air. Also for metering and measuring. 600 lbs. S. W. P. or 2000 lbs. C. W. P. The ORIFICE plate is furnished in cold rolled 18-8 stainless steel. ORIFICE plate and gaskets are set in a groove of solid steel to safeguard against blowing of gaskets and resultant trouble. The ORIFICE union has extra heavy ends and nut with the nut threads permanently lubricated.

SIZES ¼" TO 3"

Petro



SIZES ⅛" TO 3"

AMERICA'S MOST UNIVERSALLY USED UNION

PETRO unions have integral steel to steel seats. Made to A. A. R. design. 600 lbs. S. W. P.-2000 lbs. C. W. P. Extra heavy ends and nut with nut threads that are permanently lubricated. The seats are machined and cold rolled.

A PARTIAL LIST OF PROVEN SERVICES

Pressures from a vacuum to 3000 lbs.: Temperatures from 100° below zero F. to 1000° above zero F.: On Steam, Gas, Air, Oil, Gasoline, Ammonia, Chemicals, and any service in which Steel or Wrought Iron Pipe is Used.

ORIGINATORS AND PIONEERS OF FORGED STEEL UNIONS SINCE 1912

WRITE FOR PAMPHLET AM-67 • ORDER BY TRADE NAME FROM YOUR JOBBER

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Code). The special committee for this revision submitted its draft in January.

The first hearing will open Thursday, May 1 at 8 p.m. at the Rice Hotel in Houston, Texas and will continue May 2 at 9:30 a.m. Sponsor will be the ASME South Texas Section. The second hearing will be at the Biltmore Hotel in Los Angeles on Wednesday, May 7 at 9:30 a.m., with the Southern California Section sponsoring.

Members of the Boiler Code Committee with its subcommittees expect to travel in a group to attend the hearings and to remain for their May meeting at the Biltmore, Los Angeles, on Friday, May 9.

The purpose of the hearings is to provide an opportunity for verbal comment and discussion of the proposed revision. The Boiler Code Committee is anxious to attract pressure vessel manufacturers and users, state officials, representatives from the petroleum industry, enforcement authorities and any others interested.

Copies of the proposed revision are obtainable from the ASME, 29 West 39th Street, New York 18, N.Y. at $1.00 per copy. Comments in writing to the Secretary of the Boiler Code Committee are invited.

UNIT HEATER GROUP ELECTS OFFICERS

At the Twenty-first Annual Meeting of the Industrial Unit Heater Association held at New Orleans, February 10-11, 1947, the following officers were elected for the ensuing year: R. H. Nelson, President; R. J. Resch, Vice-President; L. O. Monroe, Secretary-Treasurer.

Mr. Nelson is President of The Herman Nelson Corp., Moline, Ill., and Mr. Resch is President of McQuay, Inc., Minneapolis, Minn.

NAFM ELECTS OFFICERS

At the Thirtieth Annual Meeting of the National Association of Fan Manufacturers held at Gulfport, Miss., February 12-13, 1947, the following officers were elected for the ensuing year: T. J. Flanagan, President; G. C. Derry, Vice-President; L. O. Monroe, Secretary-Treasurer.

Mr. Flanagan is President of Garden City Fan Co., Chicago, and Mr. Derry is Vice-President and General Manager of B. F. Sturtevant Co., Boston.

SMOKE ABATEMENT COMMITTEE'S PLANS

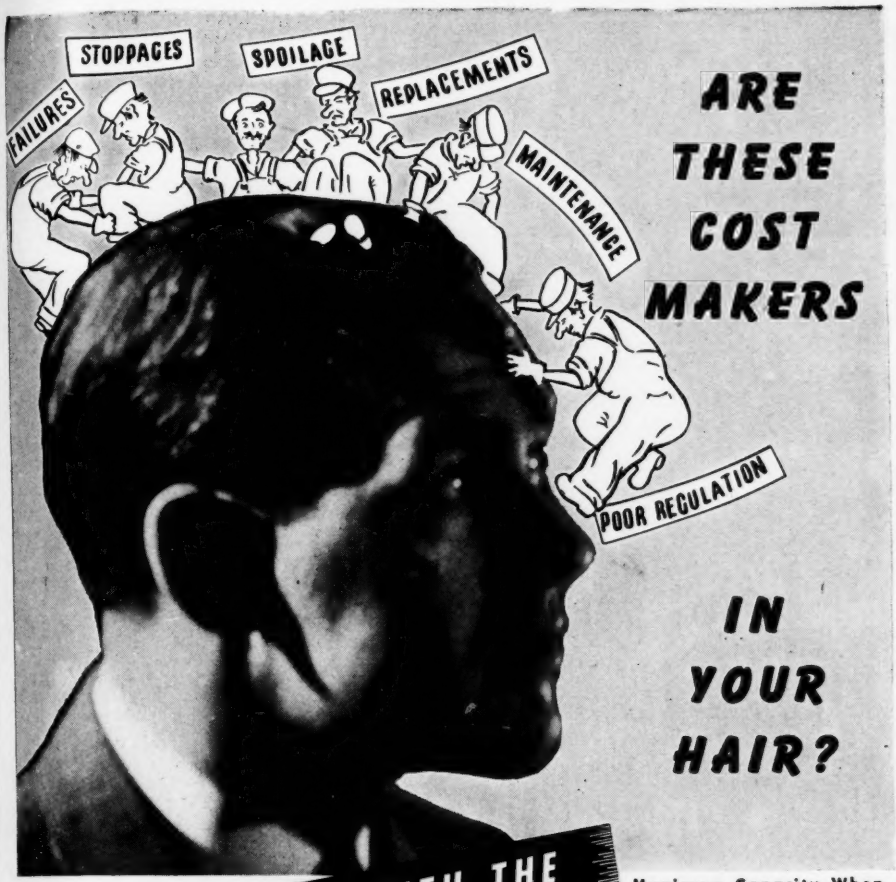
Because of the great demand by cities throughout the country for technical information concerning smoke abatement, the Coal Producers Committee for Smoke Abatement recently voted to increase its engineering personnel.

During 1946 more than 60 cities were visited, R. E. Howe, chairman of the committee announced. "In many of these cities complete surveys of cross-sections of the heating and power plants were made, from which it was possible to make a comprehensive analysis of the pollution problems of the individual municipalities. These cities now have a workable plan to bring about the abatement of smoke."

Mr. Howe pointed out that the requests for assistance come to the committee from cities regardless of the type of fuel burned. He cited Los Angeles which burns no coal at all; Roanoke, Va. which burns nothing but coal of the lowest volatile content. "Yet both cities are constantly exercised about their air pollution problems."

Henry Hebley, Director of Research, Pittsburgh Coal Co., Pittsburgh, Pa., was elected vice-chairman of the Coal Producers Committee for Smoke Abatement at the meeting. A special sub-committee on railroads was named at the meeting.

It was announced that the next smoke abatement survey would be made in Detroit, Mich. A request to assist in this work was received this week from Mayor Edward J. Jeffries, Jr. It was pointed out that Detroit was a typical example to prove that smoke abatement is a technical job and not one that can be achieved by legislating against certain types of fuel. Detroit has a preponderance of gas and oil consumers and most domestic consumers use best grades of low volatile coal.



ARE THESE COST MAKERS IN YOUR HAIR?

GET THEM OUT WITH THE CASH STANDARD *Streamlined* PRESSURE REDUCING VALVE TYPE 1000

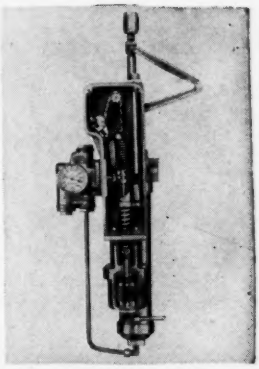
Maximum Capacity When Needed Most • Accurate Pressure Control Under Toughest Working Conditions • Trouble-Free Service • Smooth Operation • Tight Closure • Accurate Regulation • Speedier Production Results • Elimination of Failures • Constant Delivery Pressure • Cost Saving Operation • No Spoilage • Practically Zero in Maintenance Costs

Excellence in valve performance — that continues for years — takes these trouble makers "out of your hair" and keeps them out. You can forget about them immediately upon installation of the CASH STANDARD Streamlined Valve, for it does a job that users rate as excellent. Find out more about this excellence of performance by sending for Bulletin 962. See why the benefits listed on this page can be yours.

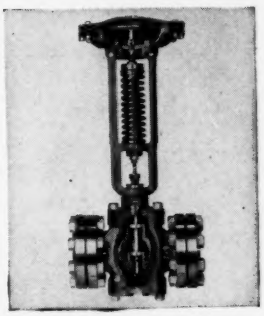
CASH STANDARD CONTROLS... VALVES

A. W. CASH COMPANY
DECATUR, ILLINOIS

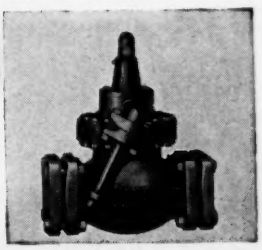
BULLETINS AVAILABLE ON OTHER CASH STANDARD VALVES
Send for them



Bulletin 963 features the CASH STANDARD Type 100 Series of Super-Sensitive Controllers — various types for automatically operating valves, dampers, rheostats, stokers, pulverizers, fans, and other apparatus. 16 pages filled with descriptions and applications.



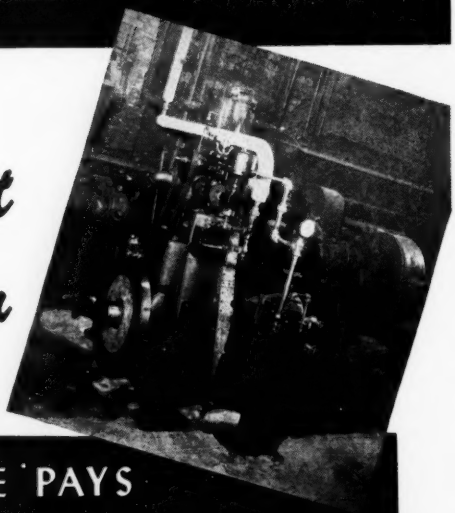
Bulletin 968 features the CASH STANDARD Type 34 Pressure Reducing Valve — direct operated — direct acting for handling steam, hot water, cold water, air, oil, brine—and most liquids and gases except some injurious chemicals. Illustrates and describes the different styles available and tells about their applications: Three pages of capacity charts.



Bulletin 956 features the CASH STANDARD Type 4030 Back Pressure Valve — designed to automatically maintain a constant pressure in the evaporator corresponding to a constant temperature desired. Shows an Ammonia and Freon Gas Capacity Chart based on ABSOLUTE pressures.

PUT STEAM FULLY TO WORK

...By-Product Power

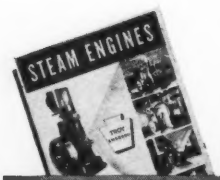


THE ENGINE PAYS FOR ITSELF AFTER A FEW MONTHS ON THE JOB!

If you use steam for heating or processing you can probably cut power costs by installing a Troy-Engberg Steam Engine and using By-Product Power to drive stokers, generators, compressors, pumps or blowers.

With proper plant heat balance you use steam direct from the boiler to run the engine and THEN introduce the exhaust into your processing or heating. The engine acts as a reducing valve, producing POWER at the same time. It's By-Product Power. It's exceptionally cheap power.

Consult our engineers about saving with By-Product Power.



TROY ENGINE & MACHINERY COMPANY

Established 1870

899 Railroad Avenue Troy, Pennsylvania

TROY-ENGBERG

STEAM ENGINES • GENERATING SETS • GENERATORS

NEW COLORADO NATURAL GAS LINE

APPROVAL by Denver taxpayers of a new 20-year franchise for the Public Service Co. of Colorado at a special election calls for immediate construction of a $12,000,000 natural gas pipeline to Denver by the Colorado Interstate Gas Co.

The pipeline, to be built between Denver and either the Hugoton Field in Kansas or the Amarillo Field in Texas, is planned for completion in time for this winter's heating requirements.

Another estimated $12,000,000 is to be spent for additional facilities on the pipeline system when necessary to meet gas requirements. In addition, Public Service Co. will be required to spend about $10,000,000 during the next five years for enlargement of its gas distribution system in Denver.

STANDARD GAS AND ELECTRIC PLANS LIQUIDATION

AT A MEETING held recently, Directors of Standard Gas and Electric Co. approved recommendations of a program for the elimination of its debt and the liquidation of the Company.

The program calls for the immediate sale of Standard's holdings of Common stock of Mountain States Power Co. and The California Oregon Power Co., the proceeds from which sales are to be applied in reduction of the Company's bank loans. The sale of such other assets as are required for that purpose will be made at the earliest feasible date.

The Company has been authorized to employ Stone and Webster Service Co. and J. Samuel Hartt, independent engineers, to prepare studies of the assets of Standard for the purpose of determining a fair and equitable basis on which Standard may base a plan of allocation of its remaining assets to its stockholders for the purpose of liquidating Standard Gas and Electric Co. in compliance with the provisions of the Public Utility Holding Company Act of 1935. It is the intention that such a plan will be presented to the Securities and Exchange Commission at the earliest possible date.

DIESEL MANUFACTURERS EDUCATIONAL CONFERENCE

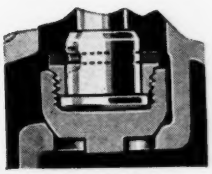
AN INTENSIVE, one-week educational conference for college and university professors who teach courses in Diesel engineering has just been announced by the Diesel Engine Manufacturers Assn. The conference, combining tours of Diesel engine factories, visits to mechanical engineering school laboratories, and classroom lectures, is the first of its type ever to be given.

During the week of June 23, fifty professors from all sections of the country will headquarter at Chicago's Hotel LaSalle. They will follow a program that includes visits to engineering laboratories of the Illinois Institute of Technology and of Northwestern University, and factory tours of the General Motors plant at LaGrange and the International Harvester Co. in Chicago. Supplementing these inspection tours will be classroom talks on various Diesel engine topics.

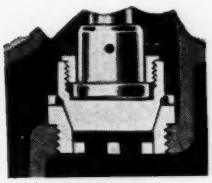
AIEE NOMINATIONS

THE NOMINATING Committee of the American Institute of Electrical Engineers, consisting of members from various parts of the country, has nominated the following official ticket of candidates for the offices becoming vacant August 1, 1947: For President: Blake D. Hull, Chief Engineer, Southwestern Bell Telephone Co., St. Louis, Mo. For Vice-Presidents: (Middle Eastern District) G. W. Bower, Haddonfield, N.J.; Public Service Electric & Gas Co., Newark, N.J. (Southern District) J. H. Berry, Manager, Norfolk District, Electric Dept., Virginia Electric & Power Co., Norfolk, Va. (North Central District) I. M. Ellestad, Transmission Engineer, Chief Engineer's Dept., Northwestern Bell Telephone Co., Omaha, Nebr. (Pacific District) D. I. Cone, Transmission and Protection Engineer, Pacific Telephone & Telegraph Co., San Francisco, Calif. (Canada District) D. G. Geiger, Transmission Engineer, General Engineering Dept., Bell Telephone Co. of Canada, Ltd., Toronto, Ontario.

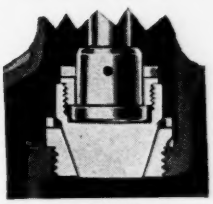
HOW TO GET LONGER SERVICE FROM GLOBE AND ANGLE VALVES



Re-Grinding Type
for occasional throttling service

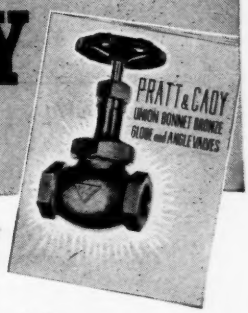


Semi-Plug Type
for frequent throttling service



Full-Plug Type
for severe throttling service

READING-PRATT & CADY



Send for this file-size folder
Just ask for DH-1032

THESE THREE TYPES of union bonnet bronze globe and angle valves could be called "good, better, best." And if you are interested in ultimate costs, it will pay you to select a better valve than the service requires. Here's why:

The semi-plug type costs one-third more than the re-grinding type—lasts four times as long. The full plug type costs two-thirds more than the re-grinding —lasts eight times as long.

These figures are, of course, approximate. But they do serve to illustrate a point. And the point is —get in touch with your Reading-Pratt & Cady distributor for bronze globe and angle valves.

Reading-Pratt & Cady Distributors Are Located in Principal Cities

ACCO

Reading, Pa. • Atlanta • Baltimore • Boston • Chicago • Denver • Detroit • Houston • Los Angeles • New York • Philadelphia • Pittsburgh • Portland, Ore. • San Francisco • Bridgeport, Conn.

READING-PRATT & CADY DIVISION
AMERICAN CHAIN & CABLE

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FLAX PACKINGS

Outstanding in Quality and Uniformity

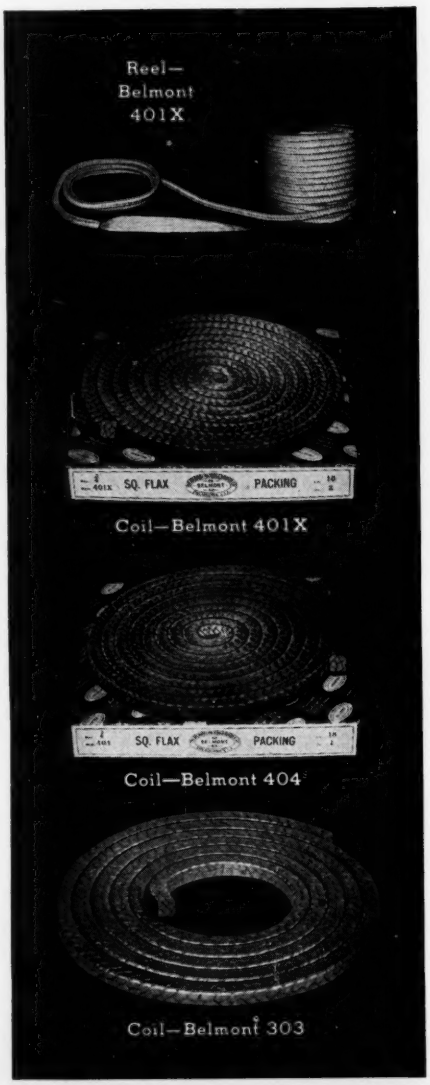
CAREFUL selection of raw flax and the control of various processes of hackling, spreading and drawing to provide suitable rovings for braiding and finishing . . . are responsible for the consistent high quality of Belmont Flax Packings.

BELMONT 401X (Coil or Reel) — Best quality Line Flax Fibre of selected length and strength.

BELMONT 404 (Coil)— Pure flax fibre of next fibre length to Line Flax.

BELMONT 303 (Coil)—Line Flax of selected quality, with coarse and short fibres extracted. Treated with waterproof lubricant, and surface graphited.

Just as Belmont Packings are uniform in quality, so are they, wherever practicable, uniformly packed in attractive and secure boxes bearing our orange colored trade-mark on a blue background.



THE BELMONT PACKING & RUBBER CO. — TRADE BELMONT MARK — PHILADELPHIA, U.S.A.

And . . . you can get Belmont Packings locally — distributors are located in every large industrial center, ready to serve.

THERE'S A BELMONT PACKING FOR EVERY SERVICE

Steam, Water, Oil, Gas, Air, Acids, Alkalies, Ammonia

Rings, Spirals, Coils, Reels, Spools, Sheets, Gaskets.

THE BELMONT PACKING & RUBBER COMPANY
BUTLER AND SEPVIVA STREETS • PHILADELPHIA 37, PA.

A. C. KIRKWOOD FORMS NEW FIRM

ARTHUR C. KIRKWOOD has announced the formation of A. C. Kirkwood & Associates. The new engineering firm is located in the Wirthman Building, Kansas City 3, Missouri. Services offered include reports, appraisals, rate studies, and consultation, all fully complemented by engineering design services.

Mr. Kirkwood, founder of the firm, has had broad experience in the field of consulting engineering. After graduating in 1923 from Stanford University with a Bachelor of Arts degree in Mechanical Engineering, he received in 1924 the degree of Master of Science in Electrical Engineering from the Massachusetts Institute of Technology. Initial employment was with Wood & Weber, consulting engineers of Denver, Colorado. Until late in 1929 he worked for that firm and the Utility Department of the City of Colorado Springs as draftsman, resident engineer, and designer in connection with steam and hydraulic power plant projects, transmission lines, electric distribution systems.

For the past seventeen years Mr. Kirkwood has been associated with the Burns & McDonnell Engineering Co. as associate and principal engineer. During these years he has had responsible charge of a wide variety of engineering projects located in many parts of the country from California to Massachusetts, and from Florida and Louisiana to Michigan.

STANDBY ENGINE-GENERATOR FOR RESTRICTED SPACE INSTALLATION

FACED WITH a growing standby power requirement for the City of Needles, Calif., the California Pasific Utilities Co. recently placed in service a pair of Sterling 600 hp natural gas engines powering a single 875 kva generator. This unusual installation successfully met the following basic requirements: 1. Lowest first cost consistent with quality and reliability—installed cost was approximately $40 per kw. 2. Quick starting with minimum preliminary preparation—direct electric battery starting. 3. Simplicity of installation and operation—single generator. 4. Minimum floor space requirements.

The only space available for installation of an additional unit was along the south wall with a floor area of 7 ft 3 in. by 36 ft less allowance for a 9 ft 6 in. door. In order to meet requirements, two 8 x 9 engines were placed end to end with a General Electric 875 kva 1200 rpm alternator between the two engines and connected by means of special couplings to the alternator. Actual engine-generator base overall dimensions were 6 ft by 28 ft including generator. The couplings provide for disconnecting either engine while permitting single engine operation if necessary. Excitation is furnished by an auxiliary m.g. set.

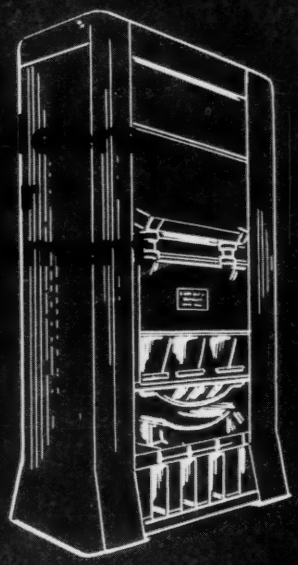
Propane gas is used for fuel, being available from the gas distribution system of the utility for the City of Needles. Exhaust stacks carried outside the building incorporate a heat exchanger for vaporizing the propane prior to admission to the Ensign gas carburetors at the engine. Temperature control in the heat exchangers is effected by bleeding a portion of the raw cooling water into the exhaust lines.

Engines are controlled by a dual panel system. A single throttle control on panel 1 of the main switchboard is used to synchronize the engine driven alternator when throwing onto the line. Load division between the engines is obtained by regulating remote engine throttle control at the engine panel to bring manifold pressure readings equal.

The operating experience with this unit has been extremely satisfactory with numerous emergency runs to maintain service to the City of Needles. One outage called for a continuous 10-hour run on the line with the unit delivering 850 kw continuously for two hours out of the ten. In view of the outstanding performance of this unit and the comparatively low investment per kw for stand-by power the California Pacific Utilities have placed an order for a duplicate machine for their Winnemucca Nevada utility. The installation of these engines was made by the King-Knight Co. of San Francisco.

Some very important reasons...

why so
Machiner
select ROS
Original Eq

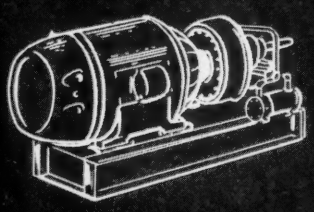


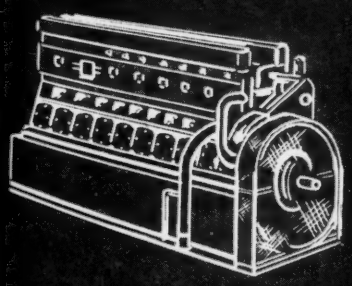
ROSS "BCF" COOLERS

Machinery builders show a heavy preference for the Ross "BCF" design for cooling oil, water and other fluids up to 250 GPM. Accordingly, a high percentage of Diesels, compressors, hydraulic presses, torque converters, reduction gears and turbines includes this Ross cooler as original equipment.

Why Ross? Why the "BCF"? For the same reasons that thousands of *USERS* have made this selection for many, many years:

- *Small, light weight, compact.*
- *Strong, durable, corrosion resistant.*
- *Made entirely of non ferrous materials.*
- *High heat transfer rate.*
- *Features adaptable to individual needs.*
- *Easily inspected and cleaned.*
- *Simple to install.*





FREE ON REQUEST
Complete details in Bulletin 4922. Write on your Company letterhead.

ROSS HEATER & MFG. CO., INC.
Division of American Radiator & Standard Sanitary Corporation
1428 WEST AVE. BUFFALO 13, N. Y.

...with De-ionized Water for your boiler feed

ILLCO-WAY It's easy to eliminate silica from your list of boiler feed troubles! ILLCO-WAY De-ionizers *now remove silica by ion exchange.* Silica in feed water for high-pressure systems is reduced to less than .5 ppm!

ILLCO-WAY With this same equipment you prevent boiler scale, corrosion, and embrittlement—because De-ionized Water is free from dissolved solids. ILLCO-WAY De-ionizers will produce thousands of gallons of silica-free water for only a few cents.

ILLCO-WAY Investigate this new process that keeps your boilers clean by ion exchange. Long a pioneer in water treatment engineering, ILLCO-WAY now offers the new scientific way of De-ionizing to "Stop Old Man Silica." Write for literature today.

ILLINOIS WATER TREATMENT CO.
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7310-PP5 Empire State Bldg., New York

TESTED IN THE LABORATORY * ILLCO-WAY * PROVED IN THE FIELD

Boiler Feed-Water Treatment

Complete equipment for Chemical Processing: Purification of industrial wastes, Separation of Chemical Solutions, Purification of Chemical Solutions, Reclamation of Valuable Constituents

DISCLOSE GERMAN FUEL PREPARATION PRACTICES

COAL PREPARATION practices in Western Germany are described in a new publication released by Dr. R. R. Sayers, Director of the Bureau of Mines. The report is one of a series written by members of the Solid Fuels Mission to Germany on wartime developments in coal mining, preparation, and utilization.

Information on technological or organizational developments unknown to the America coal industry, discovery of any new devices or techniques for preparing special grades of coal for emergency war needs, and the "know-how" on German methods of preparing coal for conversion to liquid fuels were the three-fold objectives of the study. Leading German coal-preparation plants were visited, and German manufacturers and designers—responsible for new plants and the latest technologic developments—were consulted.

A copy of the publication, Information Circular 7389, "Coal Preparation Practices in Western Germany," may be obtained free from the Bureau of Mines, Department of the Interior, Washington 25, D.C.

FPC CONSIDERS CURE FOR FUTURE GAS SHORTAGES

AT THE invitation of the Federal Power Commission, representatives of State Utility Commissions met recently in the FPC Hearing Room, 1800 Pennsylvania Ave. N.W., Washington, D.C., to outline the situation with regard to shortages of natural gas within their respective states and to make suggestions for developing a long range plan for coping with such shortages as may develop during the heating season of 1947-48. Areas represented included the Appalachian, Midwest and Southern parts of the country where it has been necessary to adopt curtailments this winter.

Due to demand far beyond estimates for 1946-47 many gas utilities were forced to make severe curtailments during low temperature days and estimates based upon this year's recent peak day demands indicate that the delivery capacity of pipeline systems will fall far short of the demand for the winter season of 1947-48.

The FPC has undertaken to cooperate with the various State Commissions in making plans to be prepared for next winter's shortages and reduce their severity by long-range and coordinated planning.

RWMA ANNOUNCES NEW OFFICERS

GEORGE N. SIEGER, President of S-M-S Corp., Detroit, was elected president of the Resistance Welder Manufacturers Assn. at its annual meeting at the Book Cadillac Hotel, Detroit recently.

For the past two years, Mr. Sieger has been most active in the expansive Publicity and Promotional work in which RWMA has engaged.

T. S. Long, Vice President and General Manager of the Taylor-Winfield Corp., Warren, Ohio, was elected to serve as the Association's Vice President. Mr. Long has been extremely active in the work of the Association for several years, serving during 1946 as Chairman of the Arbitration Committee.

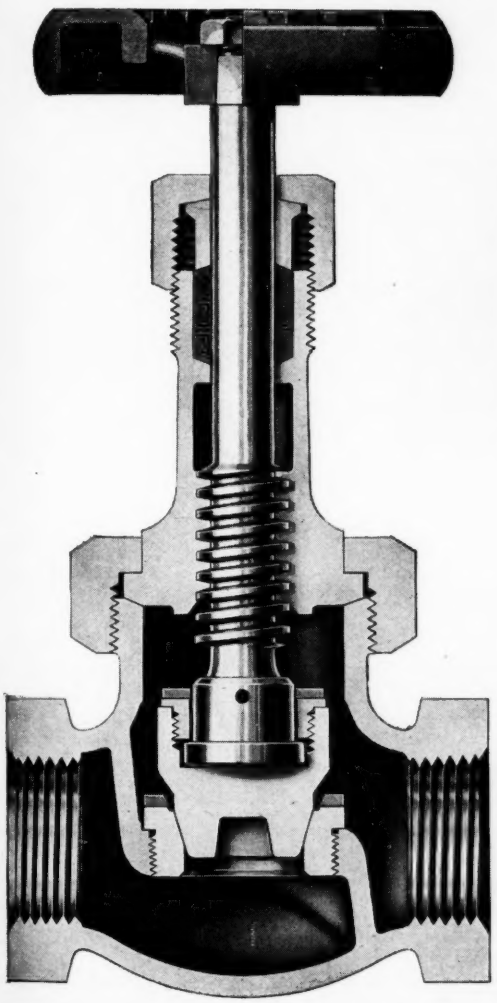
ASHVE TO MEET IN CALIFORNIA

DR. B. M. WOODS, President of the American Society of Heating and Ventilating Engineers has announced that the Semi-Annual Meeting of the Society in 1947 will be held June 2 to 4 at the Hotel del Coronado, Coronado, Calif.

The Southern California Chapter of the Society will act as host for the occasion and arrangements will be carried out by a Committee headed by Robert Lowe, Los Angeles, General Chairman. This three-day meeting of the Society will be attended by members from all parts of the United States and Canada and will consist of three Technical Sessions at which nine papers on Research activities and other subjects on heating, ventilating and air conditioning will be presented.

when you see this

on the outside



Kennedy Bronze Globe Valves are available in a wide variety of types, with screwed or union bonnet, with bronze disc, renewable composition disc, regrinding, plug-type or full-way disc. Pressures up to 300-lb. steam, 600-lb. water, gas or oil. Illustration shows 300-lb. valve with plug-type disc and renewable seat ring.

you can count on wear resistance on the inside

Looking for extra wear resistance? You will find it in a Kennedy Valve. For instance, this plug-type bronze globe valve has renewable nickel-copper alloy disc and seat rings with extra wide seating surfaces. They offer real resistance to the destructive action of foreign particles and wire drawing.

Look at the illustration and you'll see many more typical Kennedy features that assure year-in, year-out service satisfaction. Full details of all Kennedy bronze and iron-body gate, globe, angle and check valves, pipe fittings, flanges, and other valves and accessories are shown in the 240-page Kennedy Catalog. Write for your copy today.

• **BUY FROM YOUR LOCAL DISTRIBUTOR**

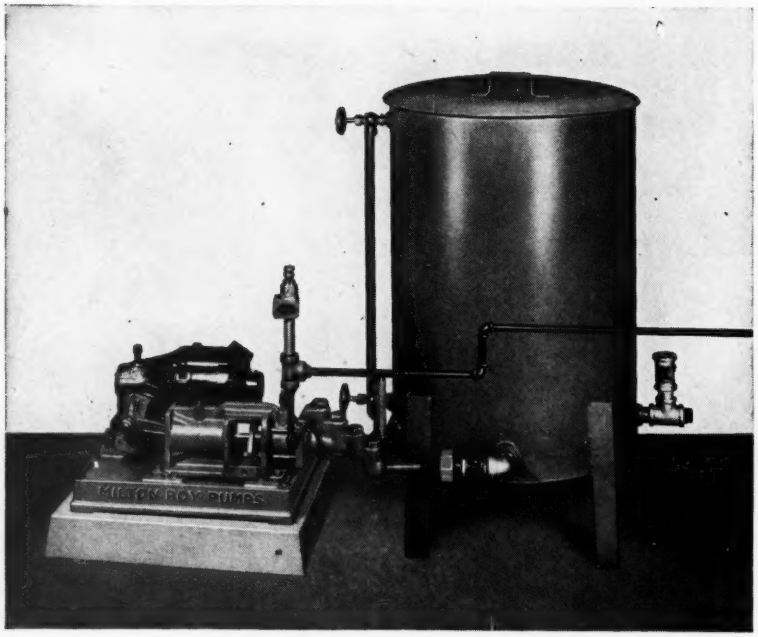
KENNEDY

valves-pipe fittings-fire hydrants

KV-147

THE KENNEDY VALVE MFG. CO., ELMIRA, NEW YORK *Offices and Warehouses in Principal Cities*

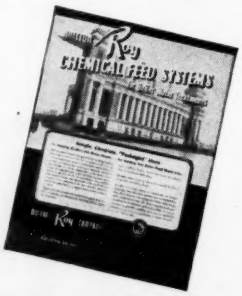
Complete *"Packaged Units"* for Chemically Treating Boiler Water



- **To remove dissolved oxygen, insure against corrosion and prevent pitting.**
- **To prevent scale formation, control alkalinity and prevent embrittlement.**

Milton Roy "Packaged Units" are available in two types, to feed Sodium Sulfite into the suction side of the feed water pump and to feed other treating chemicals, such as phosphates, soda ash and caustic, directly into each boiler. Both methods are usually necessary for the correct chemical treatment of boiler water.

These units are complete, with Milton Roy Pumps, tanks, gage glasses, low level pump cut-outs and alarms. The pumps are standard Milton Roy units. Volume of treating chemicals may be controlled precisely. Solution tanks from 50 to 500 gallons capacity are furnished. Completely automatic controls, with meters, can be supplied to operate pumps at rates proportional to the rates of feed water flow. Units are available in a wide range of capacities and to meet all pressure requirements.



For complete description of these "Packaged Units," with flow diagrams, specifications, selection tables, etc., write for Bulletin No. 451. Ask also for Technical Paper No. 51 "What the Power Engineer needs to know about Chemical Feed Systems for Water Treatment," and our new pump catalog No. 146.

MILTON Roy COMPANY

1332 E. MERMAID AVE., CHESTNUT HILL, PHILA. 18, PA.

JACKSON, VETERAN C.E. ENGINEER, RETIRES

JOHN B. JACKSON, veteran of nearly 36 years of service with Commonwealth Edison Co., Chicago, retired from active duty recently. Mr. Jackson started his career as a mechanic and rose to staff assistant in the office of the vice president in charge of engineering and operating. He was chairman of the committee of engineers which coordinated planning and construction work of the various utility companies in connection with the building of the Chicago subway. Mr. Jackson was awarded the Chanute Medal of the Western Society of Engineers in 1943 for a paper he prepared on this subject.

STEEL INDUSTRY BUYS MANY GOVERNMENT PLANTS

CLOSE TO 60 per cent of the steel-making facilities which were financed by government funds between 1940 and 1944 had been purchased by steel companies up to the start of this year. More than half of ironmaking facilities had also been sold to members of the iron and steel industry, according to an analysis of government data by the American Iron and Steel Institute.

The bulk of the purchases of iron and steelmaking facilities from the War Assets Administration took place during the last seven months of 1946. The facilities purchased by the steel industry thus far not only include steel and ironmaking furnaces, but also rolling mills, coke ovens, sintering plants and other auxiliary equipment. Purchases were made on competitive bids.

ALL-TIME HIGH FOR INDUSTRIAL EXPENDITURES

THE HIGHEST private expenditures in our history for new industrial plant and equipment were made in the fourth quarter of 1946, according to an analysis of postwar corporate finance just released by the National Industrial Conference Board.

Most postwar plant expenditure financing, says the analysis, was made possible through the use of accumulated liquid assets and not through the issuance of new stock or incurring new debt.

Bank loans were evidently not relied upon to any extent to finance additions to fixed plant and equipment. The survey points out that accumulated cash and other current resources were by far the most popular method of financing capital expenditures.

MANUFACTURING FAILURES TOP OTHERS ON LIST

FOR THE FIRST time in the history of American business, manufacturing failures outnumbered wholesaling and retailing failures in 1946. Of a grand total of 1,130 concerns failing during the year, 452 were manufacturers; their liabilities comprised $37,435,000 of a total volume of $70,349,000. Within the manufacturing division, the machinery and transportation equipment industries accounted for one-third the failures and more than half the aggregate losses. The sharp rise in these two lines resulted principally from reconversion difficulties encountered by war contractors. Failures in manufacturing were largely responsible for the upswing in average liabilities per failure from only $11,000 in 1942 to more than $60,000 in 1946. Between 1945 and 1946, however, losses were heavier in nearly every line of industry and trade. Several large failures occurred in the last three months of 1946, involving liabilities in excess of $1,000,000 and bringing total losses to the highest level in four years.

The actual total number of concerns failing and the total volume of liabilities in 1946 is not alarming when compared to the last competitive pre-war year of 1939 when 14,768 insolvencies were reported with losses aggregating $182,520,000.

William A. Danner, Parker, Danner Co., Hyde Park, Mass., was elected president of the Associated Equipment Distributors at the 28th Annual Convention held February 13-15 at the Edgewater Beach Hotel, Chicago, Ill.

You Can See for Yourself . . .

WHY the Foster 38-SV Safety Valve is ESPECIALLY SUITABLE FOR

HIGH PRESSURES HIGH TEMPERATURES

Pressures up to 3000 pounds and temperatures of 1200° F. are easily handled by the Foster Type 38-SV Super-Jet Safety Valve—it was designed especially for just these exacting requirements! It's no mere "beefed-up" low-pressure valve—rather it's a basic new design for high-pressure service.

Only the Foster 38-SV Safety Valve gives you all these advantages:

1 . . . ***Exceptional steam economy*** because . . . it reseats as low as 1% below popping pressure . . . reseating is positive; without pounding or chatter . . . blowdown is adjustable from 8% down to 1%.

2 . . . ***Unaffected by temperature changes*** because . . . frame rod construction makes crawl negligible . . . deflector protects spring and rods from escaping steam.

3 . . . ***Maximum protection*** because . . . full opening is practically instantaneous . . . full rated nozzle capacity is available at popping pressure . . . once set under operating conditions, its popping point is constant.

4 . . . ***Positive reseating*** because . . . floating disc design . . . steam-centered piston . . . permanently flat seats.

Specify the Foster 38-SV Super-Jet Safety Valve for the finest in high-pressure protection!

Complete details of the Foster 38-SV Super-Jet Safety Valve, for pressures up to 3000 pounds and temperatures up to 1200° F., are given in Bulletin 25. Write for it today!

FOSTER ENGINEERING Company

PRESSURE REGULATORS . . . RELIEF AND BACK PRESSURE VALVES . . . AUTOMATIC STOP AND CHECK VALVES . . . ALTITUDE VALVES . . . DAMPER REGULATORS . . . FAN ENGINE REGULATORS . . . PUMP GOVERNORS . . . TEMPERATURE REGULATORS . . . LIQUID LEVEL CONTROLLERS . . . FLOAT AND LEVER BALANCED VALVES . . . NON-RETURN AND TRIPLE DUTY VALVES . . . VACUUM REGULATORS OR BREAKERS . . . SIGHT FLOW BOXES . . . STRAINERS . . . SAFETY VALVES . . . SIRENS

111 MONROE STREET • NEWARK 1, N. J.

STEAM REDUCING VALVES

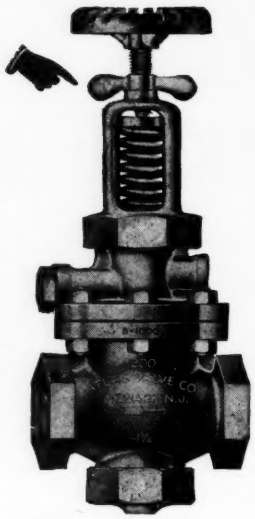
ATLAS

TRADE MARK REG

Here we show our

Type "B"

which is unequaled for services requiring tight seating and uniform reduced pressure.



With ATLAS Type "B," wide fluctuations in initial pressure have practically no effect on the reduced pressure because of the pilot operation. Renewable piston chamber, internal pilot valve, and main valve strainers. Main valve disc seats tight because disc stem is guided by center bearing cast integral with seat ring. Control diaphragm and controlled pressure port are integral with the valve body. The main valve is caused to open wide and close tight with slight changes in the reduced pressure through the operation of the pilot.

This excellent valve is also simple to maintain. Main valve disc and pilot valve are easily removed for cleaning or regrinding. The entire pilot valve can be lifted out by merely removing diaphragm cap and unscrewing pilot valve seat.

For 250 lb. Service Iron Body

Flanged Ends — Bronze or Nickel Alloy Seats and Valves —Pilot Operated. For initial working pressures from 20 to 250 lb. saturated steam: for reduced working pressures from 1 lb. to within 20 lb. of initial pressure in one stage. Sizes: 2½", 3", 4", 5", 6", 8".

For 300 lb. Service All Bronze

Screwed or Flanged Ends — Bronze or Nickel Alloy Seats and Valves — Pilot Operated. For initial working pressures from 25 to 300 lb. saturated steam: for reduced working pressures from 1 lb. to within 20 lb. of initial pressure in one stage. Sizes: ½", ¾", 1", 1¼", 1½", 2".

For 400 and 600 lb. Service with Temperatures To 900° F, Steel Body

Series 40 for steam service to 400 lb.
Series 60 for steam service to 600 lb.

Monel Metal, Stainless Steel and Nitralloy Seats—Stainless Steel Piston and Piston Chamber — Flanged Ends — Pilot Operated. For reduced working pressures from 1 lb. to within 30 lb. of initial pressure in one stage. Designed and built to withstand severe corrosion and wearing service under high pressure and temperature conditions. Sizes: ½", ¾", 1", 1¼", 1½", 2", 3", 4", 6".

Write for Bulletin No 1 A.

This bulletin tells all about Type "B". Also, for information on other ATLAS products check the following list and mail to us with your name, firm name, and address.

☐ Damper Regulators ☐ CAMPBELL Boiler Feed Water Regulators ☐ Float Valves ☐ Thermostats
☐ Temperature Regulators ☐ Oil Control Cocks ☐ Balanced Valves
☐ Exhaust Control Systems ☐ Pump Governors ☐ Pressure Regulators ☐ Humidity Controllers ☐ Control Valves

ATLAS VALVE COMPANY

REGULATING VALVES FOR EVERY SERVICE

Specialists in Regulation for Nearly a Half Century

291 SOUTH ST., NEWARK 5, N. J.

Representatives in Principal Cities

INSTRUMENT CONFERENCE AND EXHIBIT

IN CONNECTION with the Second National Instrument Conference in Chicago, September 8-12, 1947, the Instrument Society of America will again conduct an Instrument Exhibit.

The exhibitors at the 1946 Show had a 30 day option on the space in the Stevens Hotel Exhibition Hall. The general sale of exhibit space was announced on February 1st. Information on reservations can be obtained from T. W. Robinson, Chairman of the Exhibit Committee, 236 North Clark Ct., Chicago 1, Ill.

The National Chairman of the Conference Committee is A. F. Sperry, Hubbard Engineering Co., Chicago. The Chairman of the Chicago Committee for the Conference and Exhibit is Hugh Ferguson, People's Gas, Light and Coke Co.

MANUFACTURERS' *News*

JOHNS-MANVILLE ACQUIRES GOETZE

COMPLETION of the purchase, on March 31, of the factories and other properties of the Goetze Gasket & Packing Co., Inc., of New Brunswick, N.J., by Johns-Manville was announced recently. By the terms of the purchase, under an agreement signed in February, Johns-Manville also acquires the going business of Goetze.

Goetze gaskets will be produced as formerly at the Goetze plant in New Jersey and will be sold under the Goetze name by Johns-Manville. It is also expected that an expanded use will be made of the Goetze plant facilities, skilled craftsmanship and highly specialized knowledge in the manufacture of metallic gaskets. The announcement points out that the two lines will make available one of the most complete lines of packing and gaskets.

LACLEDE-CHRISTY ELECTS OFFICERS

AT THE annual meeting of directors of Laclede-Christy Clay Products Co. held recently Donald N. Watkins was elected President and General Manager of the Company, to succeed Wm. P. Hemphill.

Walter W. Shipley was elected a Vice President. Mr. Shipley has been with the Company since 1929. He was Advertising Manager and has held various positions in the Sales Department. Since 1944 he has been an Assistant Vice President.

In addition to the above, the following officers were re-elected: W. F. Godejohn, Vice President; L. C. Hewitt, Vice President; J. L. Cummings, Vice President; R. T. Risk, Secretary and Treasurer; J. H. Schoemaker, Assistant Secretary.

NEW APPOINTMENTS FOR ALLIS-CHALMERS

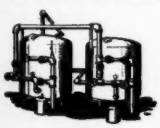
NEW APPOINTMENTS in the switchgear and control sections and the electronic group of the electrical department of the Allis-Chalmers Mfg. Co., Milwaukee, Wis., have been announced.

J. S. Morgan is named engineer-in-charge of sales, switchgear and control sections; T. G. A. Sillers is appointed engineer-in-charge of development, switchgear and control sections; C. F. Kucera becomes sales engineer-in-charge of switchgear sales, assuming responsibilities previously handled by Mr. Morgan, and E. J. Rathsack is named engineer-in-charge of the electronic group.

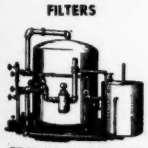
Mr. Morgan, in his new capacity, will directly supervise sales and commercial matters in the switchgear and control sections and the electronic groups. He will also co-ordinate sales and commercial affairs of the Boston Works circuit breaker section with those of the West Allis sections, which are directly under his supervision.

HIPPOPOTAMI DON'T TEST FOR HARDNESS

HOT PROCESS SOFTENERS



FILTERS



ZEOLITE SOFTENERS

REACTIVATORS

Hippopotami will take a dip in any jungle pool without a thought for the hardness content of the water.

But there is hardness in every water supply . . . hardness that must be removed or at least controlled before process use . . . hardness that must be eliminated before use as boiler feed.

The power engineer knows that long equipment life depends directly upon removal of scale-forming salts and corrosive gases. He knows that an efficient water conditioning system is necessary to do that job. Because Graver designs, fabricates and erects a full line of such equipment, you are assured of the type that best meets your requirements: zeolite, hot process or reactivator type lime and soda softeners, pressure filters and partial or complete demineralization plants.

Call in a Graver engineer today for an unbiased recommendation based on more than 35 years experience.

GRAVER TANK & MFG. CO., INC.

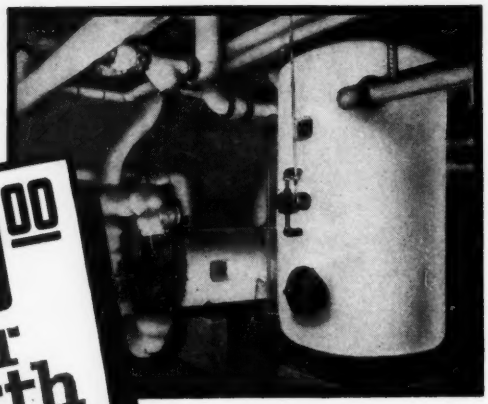
General Offices: East Chicago, Indiana

New York Philadelphia Chicago

Water Conditioning and Process Equipment Division

GRAVER

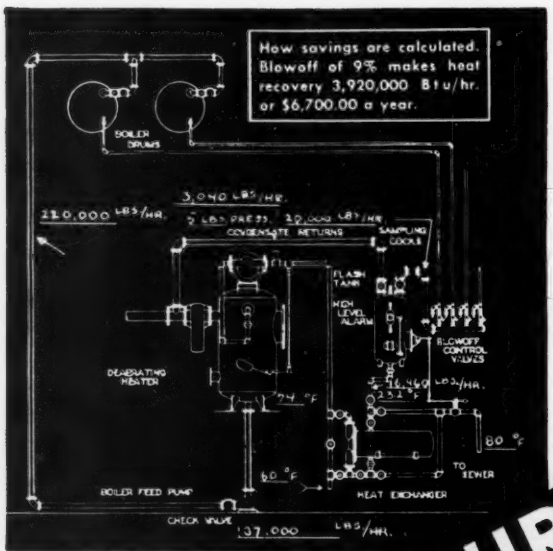
Flash tank of Cochrane Continuous Blowoff System at Union Station Power Plant, Terminal R. R. Assoc., St. Louis, Mo.



$6700.00 a year is worth SAVING!

CONTINUOUS BLOWOFF is such a money-saver, that it is surprising to find numbers of boiler plants that still rely on intermittent blowoff with its wasteful extravagance in steam and man power, to say nothing of unequal boiler concentrations. Examples like that of the Union Station Power Plant of the Terminal Railroad Association of St. Louis, where savings made possible by Cochrane Continuous Blowoff total $6,700.00 *every year,* should be convincing evidence. If *you* are not yet aware of the savings inherent in Continuous Blowoff, write today for a copy of Cochrane Publication No. 4081.

COCHRANE CORPORATION • 3123 N. 17th ST., PHILADELPHIA 32, PA.



If boilers are operated at their full capacity, delivering 200,000 lb. steam per hr. at 150 lb. per sq. in. gage pressure with a blowoff at 9% of the water fed to the boilers, the heat recovery figures out as 3,920,000 Btu per hour. This is equivalent to an annual saving of $6,700.00 when operating at full rating 24 hours per day, 300 days per year.

Continuous BLOW COCHRANE SINCE 1863 OFF System

MARINE SPECIALISTS JOIN BAILEY

BAILEY METER CO. recently announced it has added two marine service men to its staff of field engineers.

J. R. Sullivan has joined the Company's New York Branch Office, 30 Church Street. He has had 3½ years experience with marine boilers and is well acquainted with Bailey combustion control and feed-water regulators.

M. J. Bonnette is joining the Houston Branch Office of the Company located at 6539 Brompton Road. Mr. Bonnette will specialize in marine service work.

PLOMB TOOL ACQUIRES NEW PLANT

ACQUISITION of the J. P. Danielson Co. factory in Jamestown, N.Y. for the manufacture of pliers, adjustable wrenches and pipe wrenches, has been announced by the Plomb Tool Co., Los Angeles. The new plant provides additional tool manufacturing facilities in the East. Plomb's two plants in Los Angeles are now supplemented by factories in Chicago, Jamestown and Portland, Ore.

MAGNOLIA METAL ACQUIRES EVANS ENGINEERING

MAGNOLIA Metal Co. 18 W. Jersey St., Elizabeth, N.J. announces acquisition of the Evans Engineering Co. formerly of Milwaukee, Wis., now located at 1499 Arcadian Avenue, Waukesha, Wis.

The Evans organization comprising its full complement of key personnel, with the exception of Mr. Evans who died in 1946, was taken over as a division of Magnolia during January of this year.

MARSHALL ELEVATED AT RAYBESTOS

RAYBESTOS-MANHATTAN, Inc. has announced the appointment of George W. Marshall, Jr. as General Sales Manager, Asbestos Products Division of Raybestos-Manhattan, Inc. In his new position, Mr. Marshall will continue as general manager of the Asbestos Textile and Packing Division and in addition will direct the sales activities of the Corporation's Equipment Sales Division, and will make his headquarters at the Corporation's Chicago offices, 445 Lake Shore Drive.

HAGAN PURCHASES RING BALANCE INSTRUMENT

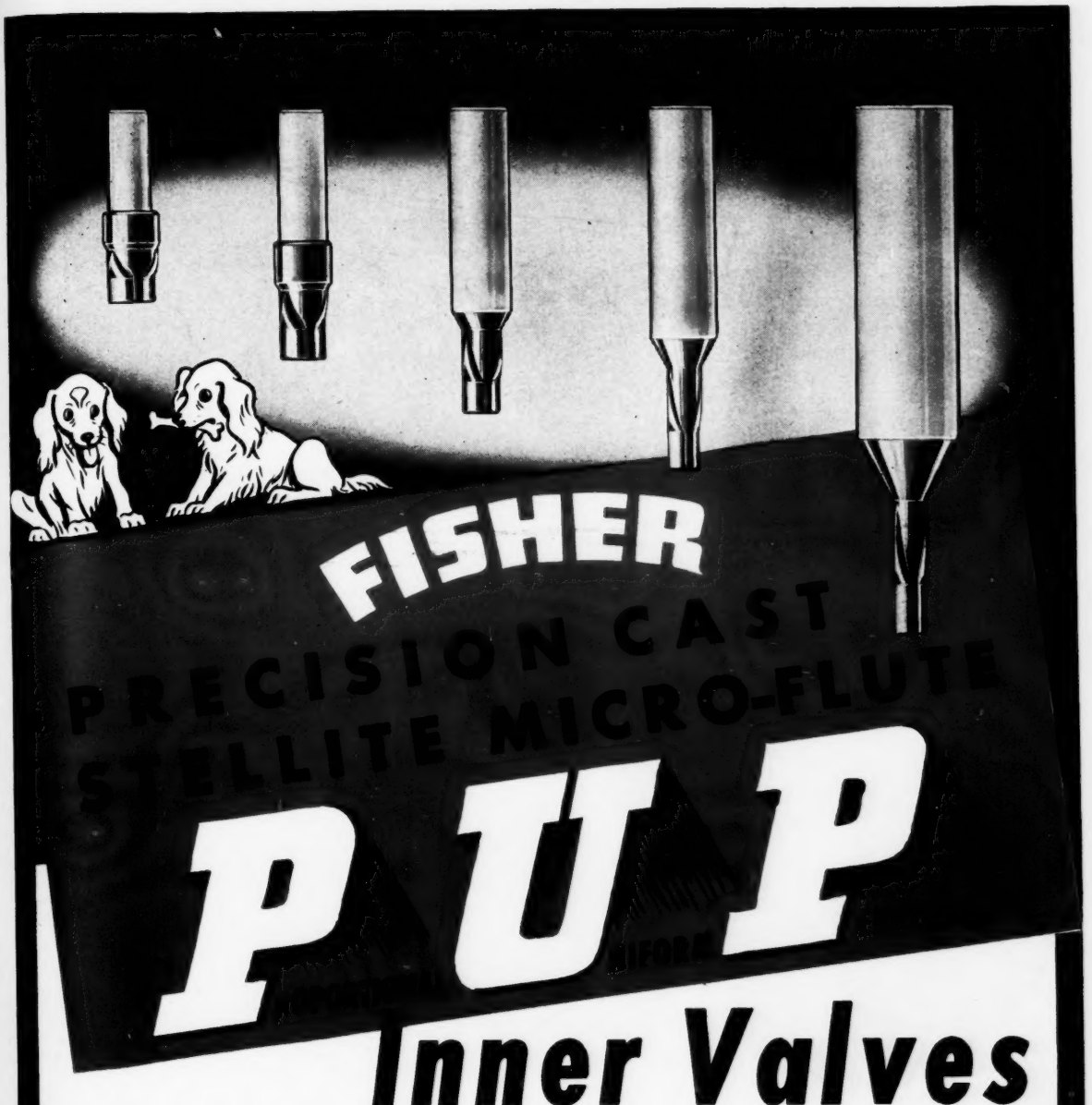
THE HAGAN CORP. has purchased the Ring-Balance Instrument Co., Chicago, thus rounding out its present combustion and process control business with a line of industrial meters, J. M. Hopwood, Hagan President, reported recently.

Transfer of control will take effect March 3, he said, but all management and other personnel of the Chicago firm will be retained and operation of its plant continued.

The Ring-Balance Co. for several years has specialized in manufacturing recording, indicating and totalizing meters for measurement of steam, liquids and gases for use in steam power plants, steel mills, central heating systems and chemical process plants. The purchase adds Hagan to the growing number of firms manufacturing both combustion control and instruments. Mr. Hopwood said also that Hagan expects to use the Ring-Balance principle on a number of new instruments not now manufactured by the company.

L & N HEAD HONORED BY UNIV. OF PENNSYLVANIA

CHARLES S. REDDING, president of Leeds & Northrup Co., received the honorary degree of Doctor of Science at the mid-winter commencement exercises of the University of Pennsylvania recently. The degree was presented by Dr. George William McClelland, president of the university, from which Mr. Redding was graduated in 1906 and subsequently served for two years as a member of the faculty. He is an associate trustee of the university.



Inner Valves

Fisher now has available Micro-Flute Pups of No. 6 Stellite. The plug end as shown above is solid cast No. 6 Stellite—precision cast by the lost wax method. The high resistance of No. 6 Stellite to erosion and corrosion—higher than any of the austenitic stainless steels—means Stellite Micro-Flute Pups will maintain their percentage flow characteristics even under most severe applications.

The base and seating surface of the ring is Stellite faced.

Solid Stellite plug end is joined to guide member by welding with stainless welding rod. Guide member is joined to stem member in same manner.

Stellite Micro-Flute Pups are available in orifice sizes of ¼", ⅜", ½", ¾", and 1". Applicable to control valve sizes ½" to 2". Bulletin A-100 gives full details. ***Write for your copy today.***

FISHER
GOVERNOR COMPANY
MARSHALLTOWN . . IOWA

DART

is a better name for Union

These two bronze seats in each Dart Union are spherical-ground to insure a drop-tight, leak-proof connection without excessive wrenching. What's more, Darts open as easily as they close, making it possible to use the same union over and over again in different locations. Body and nut are made of high-test, air-refined malleable iron and are practically indestructible. That's why it's wise to say DART when you think of UNIONS.

Your supplier will be glad to show you the many advantages of Darts.

E. M. DART MFG. CO.
Providence 5, Rhode Island

DART
UNIONS

NEW JENKINS' DIRECTORS

C. C. CHAMBERLAIN, general sales manager, and James L. Dunn, vice president in charge of industrial relations of Jenkins Bros., were elected to the board of directors of the company, it was announced recently.

Mr. Chamberlain joined the company in 1929 on graduation from Hamilton College. Starting as an assistant in the advertising department, he was appointed advertising manager in 1932, and advanced to publicity manager in 1940. He was named general sales manager in 1942.

Mr. Dunn joined Jenkins Bros. in 1913 as a valve assembler in the Bridgeport, Conn. plant. In succession he advanced to timekeeper, payroll clerk and cost clerk. After two years in service during World War I, he returned to Jenkins Bros. as rough stock clerk, He rose to production manager, business manager and assistant plant manager, and in 1944 was named vice president in charge in industrial relations.

B & W's NEW PUERTO RICO REPRESENTATIVE

THE BABCOCK & WILCOX CO., has announced the appointment of the Portilla Corp. as its agent in Puerto Rico and adjacent islands. This corporation succeeds H. Clyde Gregory, Inc., which has represented the company since 1918.

The Portilla Corp. will act as an agency for the sale, erection, and service of B & W boilers. It will also represent The Babcock & Wilcox Tube Co. and the Refractories Division of The Babcock & Wilcox Co. This is the first time that both have been represented in Puerto Rico, where Babcock & Wilcox has retained an agency for 40 years.

In addition to Puerto Rico, the Portilla Corp.'s territory will include the Virgin Islands, Republic of Haiti and Dominican Republic.

YORK-SHIPLEY EXPANDS ORGANIZATION

INDUSTRIAL Division of York-Shipley, Incorporated, York, Pa., has announced an expanded sales and service organization.

F. W. Cooper is assistant manager of the Industrial Division; J. Walz, Jr. is district manager for the middle-west; R. P. Lindemuth is district manager—middle Atlantic; and C. M. Keady, southern district manager. W. S. Tallon is application engineer for the Industrial Division; E. W. Hagblom and B. S. Shewell are field service engineers.

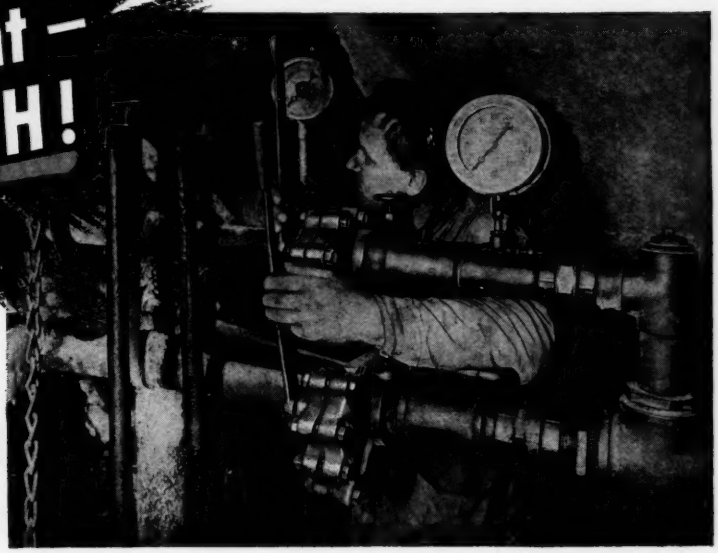
The York-Shipley Industrial Division has also expanded its distributor organization in recent months and now has exclusively franchised distributors in the following cities: Allentown, Cleveland, Tampa, Flint, Hartford, Indianapolis, Philadelphia, Buffalo, Washington, Bridgeport, Cincinnati, Boston, Chicago, New York, Watertown (N.Y.), Sheboygan, Detroit, York, Denver, Charlotte, Newark, Knoxville, Memphis, and Baltimore.

Effective February 10, 1947, the Birmingham office of the Robins Conveyors Division was consolidated with that of the Hewitt Rubber Division, both of Hewitt-Robins Inc. Since that date, the Birmingham office which was formerly in the Brown-Marx Building, has been located at 615 North 9th Street, Birmingham 4, Ala. Phone numbers: 4-0377 and 4-0378.

Walter Giger, formerly chief engineer in the railway locomotive division of Brown-Boveri & Co., Baden, Switzerland, has rejoined the Allis-Chalmers Mfg. Co., Milwaukee, Wis., and has been placed in charge of promoting the firm's interests in the transportation industry, according to a recent announcement.

General Regulator Corp. has announced the appointment of Hayden & Co., Bankers Building, 105 West Adams Street, Chicago 3, Ill., as exclusive representatives for the General Regulator Corp. in the Middle West territory comprising the states of Illinois, Indiana, Iowa, Minnesota, Wisconsin and portions of Missouri and northwestern Ohio. Carl

wide open . . . or shut tight — in a FLASH!



. . . with the Everlasting Valve

THE EVERLASTING "straight-through" Valve is used in all industry because a reliable, quick-acting, drop-tight valve is what industry wants.

That's why, when you require wide-open, full-pipeline flow in an instant, or split-second emergency shut-off . . . you can get it with an EVERLASTING Valve. Less than a 70° turn of the lever turns the trick.

What's more, the EVERLASTING Valve *improves* with use. The rotating action of the sealing disc against the seat gives the valve a self-lapped seal . . . *everlastingly tight.* For the design of the EVERLASTING Valve forces the sealing disc into constant contact with the sealing surfaces around the port. Damaging grit can't get in between.

Mechanically, the EVERLASTING Valve is simple. *It has but eleven parts in all.* Maintenance can't be a headache. And remember the self-lapping feature—it has no equal for maintaining the drop-tight seal. Furthermore, EVERLASTING Valves are designed to "take it." *And they do!*

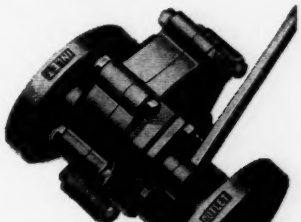
Made in straight lever and rack-and-pinion types, the EVERLASTING Valve is available in cast-iron, bronze or cast-steel. Sizes range from ½" to 6"; pressures up to 300-lb. EVERLASTING Valves conform to A.S.M.E. and other code requirements.

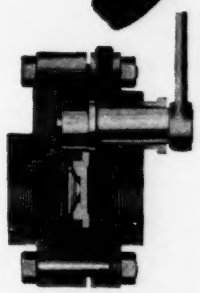
If you have a fluid-flow control problem—our engineers can help. For complete information without obligation *drop us a line for Bulletin #E-150 — today!*

EVERLASTING VALVE COMPANY • 49 FISK ST., JERSEY CITY 5, N. J.

Trade-Mark "EVERLASTING"—REG. U. S. PAT. OFF.

Flanged Straight Lever Type (Figure 1101) available for such services as Acids, Alkalis, Cellulose, Emulsions, Oil and Gasoline — as well as for Steam, Water or Air.





Cross Section View Screwed Type

To meet the fluid-flow requirements of all industry, the complete line of EVERLASTING Valves provides dependable, quick opening and drop-tight closing valves for:

Boiler blow-offs
Water column shut-offs
Air accumulators
Condenser blow-offs
Tank outlets
Equipment throttles
Plastic presses
Evaporator blow-offs
Loading rack lines
Emergency shut-offs
Process pipelines
Laundry washers
Vulcanizer blow-offs
Fire protection lines
Cleaner's and Dyer's vats
Purifier blow-offs
Compressed air tanks

EV-272

Everlasting Valves GIVE "EVERLASTING" SERVICE.

Now CHIKSAN OFFERS THE PERFECT COMBINATION For LOADING LINES

OKADEE LOADING RACK VALVES are now distributed exclusively by Chiksan Company and Chiksan Export Company. Okadee Valves have been "working on the railroad" for 50 years... and serving the Petroleum Industry for a quarter-century. The combination of Chiksan and Okadee now makes possible uniformly high standards in Loading Rack design and performance.

CHIKSAN SWIVEL JOINTS have always been noted for their unobstructed inside diameter which permits full flow. Okadee Loading Rack Valves provide corresponding high capacity. In combination, they improve loading efficiency and substantially reduce loading time. Low pressure drop saves pumping costs. Non-shock closing prevents damage to equipment. Easy operation at all pressures gives the operator perfect control. Chiksan Ball-Bearing Swivel Joints provide full 360° rotation with low torque. There is nothing to tighten or adjust. You get ALL these advantages when you specify Chiksan and Okadee for Loading Rack service. Write for full details.

CHIKSAN REPRESENTATIVES IN PRINCIPAL CITIES

EXPORT REPRESENTATIVE: Chiksan Export Co., Brea, California

Branches: New York 7, Houston 1

CHIKSAN TRADE MARK REGISTERED — BALL BEARING SWIVEL JOINTS FOR ALL PURPOSES

CHIKSAN COMPANY
BREA, CALIFORNIA
New York 7 Houston 1

F. Hayden, long associated in this field, is president of Hayden & Co.

Liquid Conditioning Corp. has moved its main office and plant to Linden, N.J. to take care of its expanding business. The new centralized facilities of the company include enlarged departments for designing, testing, research, assembly and warehousing. The location is at 114 East Price Street, Linden, N.J. Telephone Linden 2-3717.

Northern Equipment Co., Erie, Pa. announces the appointment of W. W. Hicks & Co., 567 Banning Street, Winnipeg, Manitoba for sales and service for Copes boiler feedwater regulators, pressure controls, desuperheaters and allied equipment.

MANUFACTURERS' *Personals*

DE LAVAL ANNOUNCES NEW APPOINTMENTS

HAROLD V. RASMUSSEN has been appointed Chief Engineer of the Turbine Department of the De Laval Steam Turbine Co., Trenton, N.J. Mr. Rasmussen has been associated with the company since 1941. Before coming to De Laval, Mr. Rasmussen was connected with the Westinghouse Electric Corp. from 1922-1941, first as a design engineer on industrial and central stations and marine turbines and later as Manager of Development of Land and Marine Turbines.

It also was announced that Harry Engvall had recently been appointed Chief Engineer of the Helical Gear Department. He has been associated with De Laval for 23 years.

A third appointment was that of Hans Gartmann as Chief Engineer of the Centrifugal Pump and Compressor Dept. Mr. Gartmann has been associated with De Laval since 1924, first as a designer of centrifugal pumps and compressors and later as a hydraulic engineer.

At the recent Annual Meeting of Rockwell Manufacturing Co., Pittsburgh, Pa., the Board of directors elected W. F. Rockwell, Jr., president. Mr. Rockwell formerly served as Vice President and General Manager. Col. Willard F. Rockwell, who has been both President and Board Chairman, will retain the office of Chairman of the Board. All others officers were re-elected.

William P. Barrett has been appointed representative for the General Electric Company's conduit products division in Cleveland, it was announced recently.

H. J. Fraser and H. J. French were elected as additional Vice Presidents of The International Nickel Co., Inc. it has been announced. Mr. Fraser has been Asst. Vice President since June 1943. Both he and Mr. French are Assistant Vice Presidents of The International Nickel Co. of Canada, Limited, the parent company.

George W. Kelsey, a Director and General Sales Manager of Builders Iron Foundry, Providence, R.I., for the past several years, has been named a Vice President of that concern.

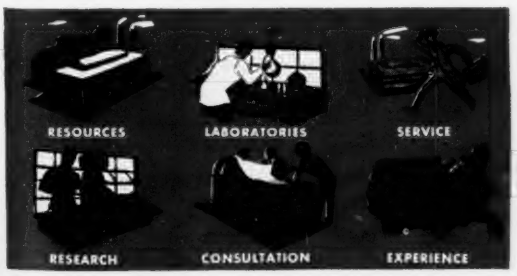
Erling Klafstad, who has been connected with the Crosby Steam Gage & Valve Co. for eighteen years as Chief Engineer, was elected a Vice President of the Company, in charge of Operations and Engineering, at a recent meeting of the Board of Directors.

Ellis L. Spray, Vice President of the Westinghouse Electric Corp., has announced the appointment of Gerald Z. Wollam as his assistant in the supervision of the Company's Elevator Division in Jersey City, N.J., and the Sturtevant Division at Hyde Park, Mass.

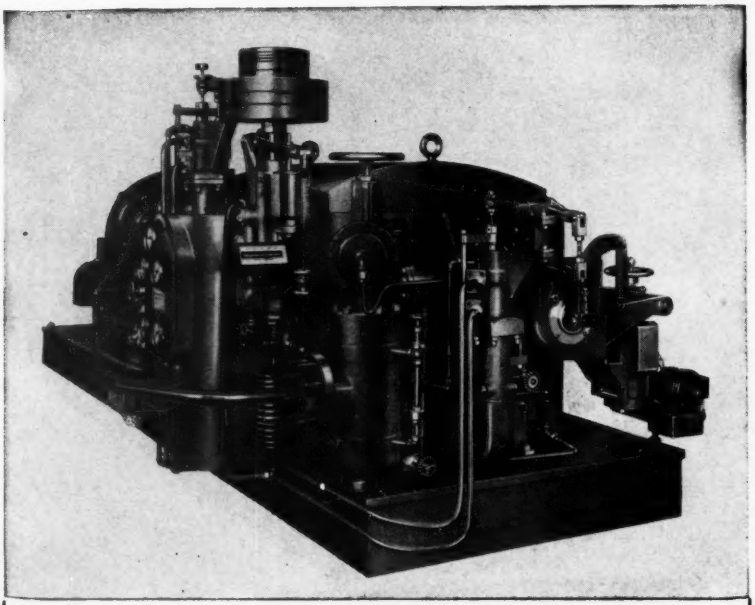
Worth looking into

RESOURCES — pictured above is the modernly equipped Drew plant where Ameroid water treatments are produced. Vast resources and the highest standards assure users of Ameroid Complete Boiler Water Treatment of quality products.

When you look into the AMEROID system you'll find it backed by all the factors necessary for a completely successful boiler water treatment . . . a national service organization of trained chemists and engineers; modern analytical laboratories; controlled manufacturing facilities; a progressive research program; and the "know how" that comes only from wide experience. An AMEROID representative will be happy to discuss boiler water conditioning with you at your convenience.



E. F. DREW & CO., INC.
15 EAST 26th STREET, NEW YORK 10, N. Y.
COMPLETE AMEROID SERVICE is available in key cities of the United States, Canada, Mexico, Brazil and Puerto Rico.



LARGE TURBINE PERFORMANCE FOR THE SMALL PLANT

An outstanding advantage of Murray Turbines is that they give the small plant many of the desirable operating economies enjoyed by larger plants.

The illustration above shows a typical job of this kind—a 175 KW Murray Extraction Turbine installed in a midwestern packing plant.

This modern unit operates with steam at 235 lb. pressure—500 deg. F. total temperature, and exhausts at 27 in. vacuum. Steam is extracted automatically at 60 lb. pressure.

Let our engineers cooperate in smoothing out your power problems.

MURRAY IRON WORKS COMPANY

BURLINGTON, IOWA

BUILDERS OF STEAM POWER EQUIPMENT FOR THREE QUARTERS OF A CENTURY

Appointment of C. Stuart Haagensen as manager of the employment department of the Allis-Chalmers Mfg. Co., Milwaukee, Wis., and of Michael F. Biancardi as manager of the firm's health and safety department, has just been announced.

Fairbanks, Morse & Co., Chicago, recently announced the appointment of John A. Cuneo as Manager of the company's Los Angeles Branch, succeeding Harry W. Brown who has retired.

The Clayton Manufacturing Co., El Monte, Calif., announces the appointment of J. A. Cortright as general sales manager, succeeding L. F. Working, retired.

Appointment of Floyd Jones as sales manager of the portable compressor division of the Davey Compressor Co., Kent, Ohio, was announced recently.

Obituaries

JOHN R. BONNELL

JOHN R. BONNELL, senior engineer, Station Efficiency Division, Commonwealth Edison Co., Chicago, died on March 14, 1947 as a result of injuries sustained several days before, when he was struck by a motor truck on a highway. He was 38 years old.

Mr. Bonnell was one of the most well-known and well-liked of the younger mechanical engineers in the Chicago area. He was a member of the ASME and active in the affairs of the Chicago section. He received his mechanical engineering education at Lewis Institute, Chicago.

He had been with Commonwealth Edison Co. since 1924, starting as a helper in the construction department. In 1929, he was transferred to the office of the Superintendent of Generating Stations as an engineer. He served there until 1937 when he was appointed engineer in the Station Efficiency Division of the company. Shortly after that, he was assigned to Northwest Station of Commonwealth Edison Co. as watch boiler room engineer and became assistant boiler room engineer at Northwest in 1941. Early in 1947 he was transferred to the Station Efficiency Division as a senior engineer, the position he held at the time of his death.

HENRY ERICSSON

HENRY ERICSSON, 85, one of the builders of Chicago and a city building commissioner under Mayor Carter Harrison from 1911 to 1915, died recently on a visit to Miami.

Mr. Ericsson was chairman of the board of Henry Ericsson Co., builders of commercial and industrial projects, which he founded in 1883. Born in Torp, Sweden, he came to Chicago as a young man of 20.

He was a charter member of the Builders' Club of Chicago, an organization of architects, engineers, and other city leaders.

He was the builder in 1890 of the Manhattan building on Dearborn St., south of Van Buren, the first 16 story building in Chicago. His firm also constructed the Pittsfield, the Continental Illinois bank building, the City Hall Square, and other Chicago buildings. He also built the Julia Lathrop housing project.

Mr. Ericsson was the author of "Sixty Years a Builder." He had served as president of the Building Construction Employers association and vice president of General Contractors Association of Amer-

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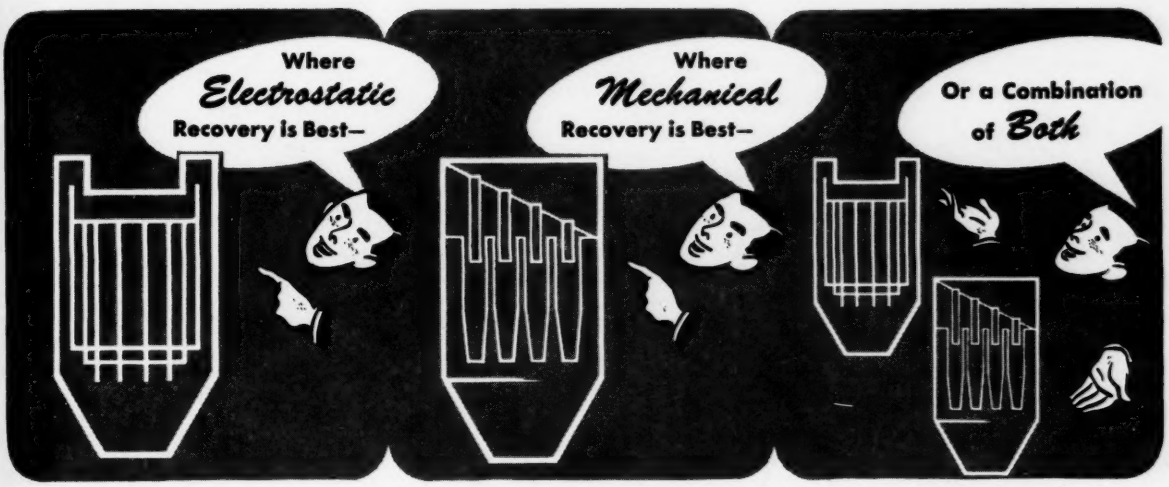

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POWER PLANT ENGINEERING

ica. He had been knighted in the "Order of Vasa" by King Gustaf of Sweden.

Surviving are four daughters, Mrs. Hazel Theis, Mrs. Florence Prather, Mrs. Martha Leverone, and Mrs. Virginia Olson; three sons, Walter H., Clarence E., and Dewey A., and 16 grandchildren.

JOHN H. ALLEN

JOHN H. ALLEN, founder and president of Everlasting Valve Co., Jersey City, N. J., died at his home, Orange N. J., February 18th. Although 89 years old, he was in active management of the company until recently.

Well-known in engineering circles, he was a director of the Machinery Club of New York and was active in the National Association of Power Engineers. For his pioneer engineering efforts, he was granted a Tau Beta Pi award in April, 1942, by Lafayette College, from which he was graduated in 1877.

The son of James and Sarah Goodlander, he was born in Montoursville, Pa., June 22, 1857. As a boy he was adopted by a relative, John Hays Allen, whose name he assumed. After leaving Lafayette, he was graduated from Philadelphia College of Pharmacy and spent two decades in the drug business.

He became a salesman for the Standard Railroad Equipment Co. in 1900 and later traveled throughout Europe and the United States selling for the Scully Iron Co., Chicago.

In 1908 he and associates founded the Patterson-Allen Engineering Co. in Jersey City, which later became the Everlasting Valve Co. Before becoming president of the company, Mr. Allen served as its general manager.

Despite his age, Mr. Allen had been in good health until last August when he suffered a heart attack while vacationing in Maine. His wife, the former Emma Lois Craig, who had been prominent in art circles, died about a year ago. Mr. Allen left no immediate relatives.

J. W. HEANEY

J. W. HEANEY, one of the original four founders of the Enterprise Engine & Foundry Co., San Francisco, died February 7th after a short illness. Born in San Francisco, May 18, 1861, Mr. Heaney was active in the formation of the company in 1886, then known as the Enterprise Foundry Co., and was early recognized as one of the outstanding iron molders of that time. Due largely to his efforts, Enterprise secured and became established in the production of the larger and more difficult casting jobs.

Mr. Heaney was elected to the office of Vice-President in 1901, and later to that of Secretary, serving in this capacity until retiring in 1942.

ROGERS ALLEN FISKE

ROGERS ALLEN FISKE, 56, general sales manager of the Bryant Machinery & Engineering Co., Chicago, died recently in Santa Fe, New Mexico, where Mr. Fiske had gone because of poor health. Mr. Fiske formerly was an associate editor of POWER PLANT ENGINEERING, Editor of Iron Age, and later was connected with the advertising agency firm of Behle & Waldie & Briggs.

Business associates said that when Mr. Fiske left for New Mexico, he and Mrs. Fiske had closed their Evanston, Ill. home. Mr. Fiske is survived by his wife and a daughter, Mrs. Dirck Brinckerhoff of Duluth, Minn.

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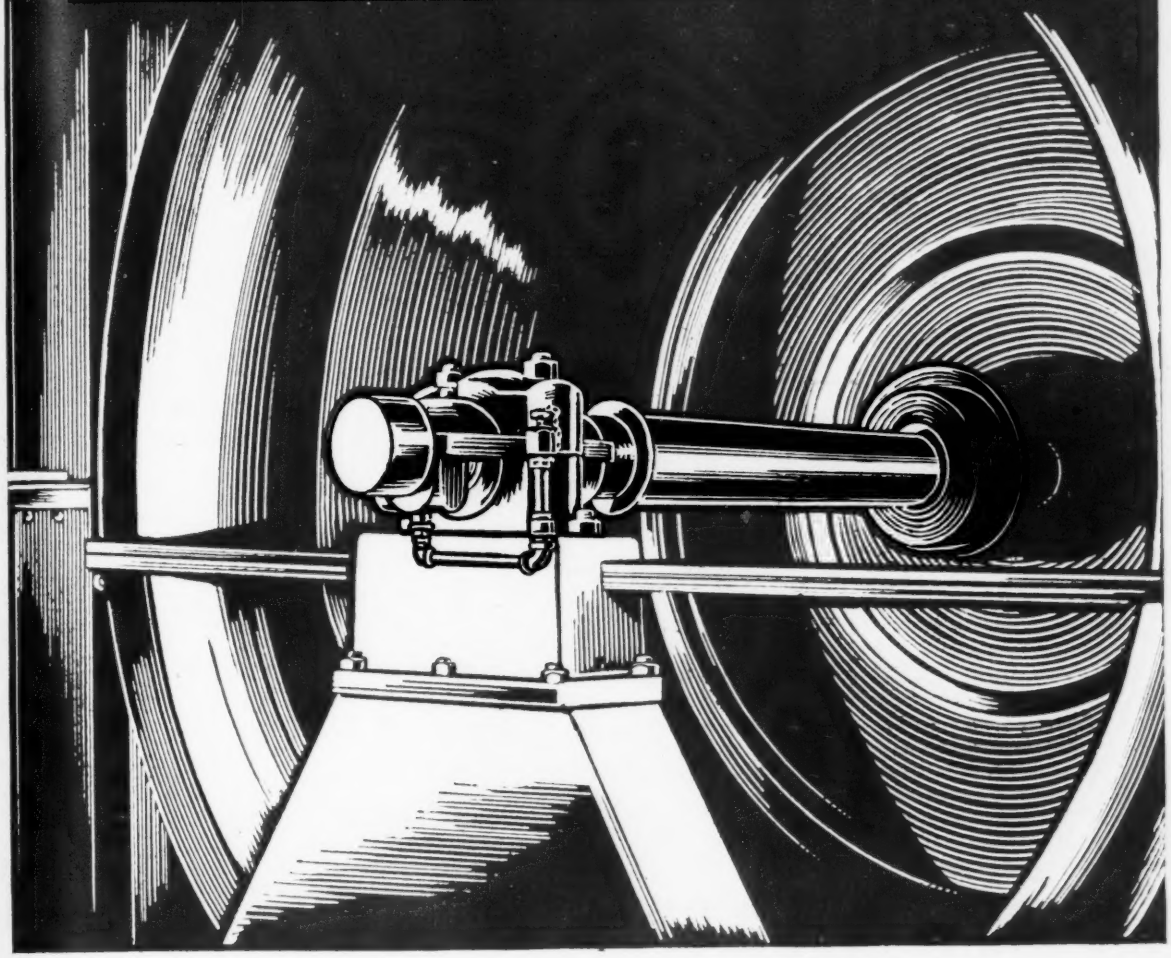

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HEAVY DUTY PORTABLE UNITS AND STATIONARY SYSTEMS ENGINEERED TO YOUR NEEDS

Vagrant dust, ash and other particles that wander about your plant are a peril to production and to workers' health . . . a cause of damage to equipment. The 100% effective and quick method to rout them is Hoffman Vacuum cleaning—long the standard dust removal equipment of leading power companies. Portable or stationary systems that clean during operation—save time and manpower. Get the facts today, without obligation.

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MIDWEST POWER CONFERENCE

(*Continued from page 111*)

such as labor and fuel costs, were discussed in some detail by Robert Krause, assistant plant manager, Container Corp. of America, Chicago.

Energy Sources

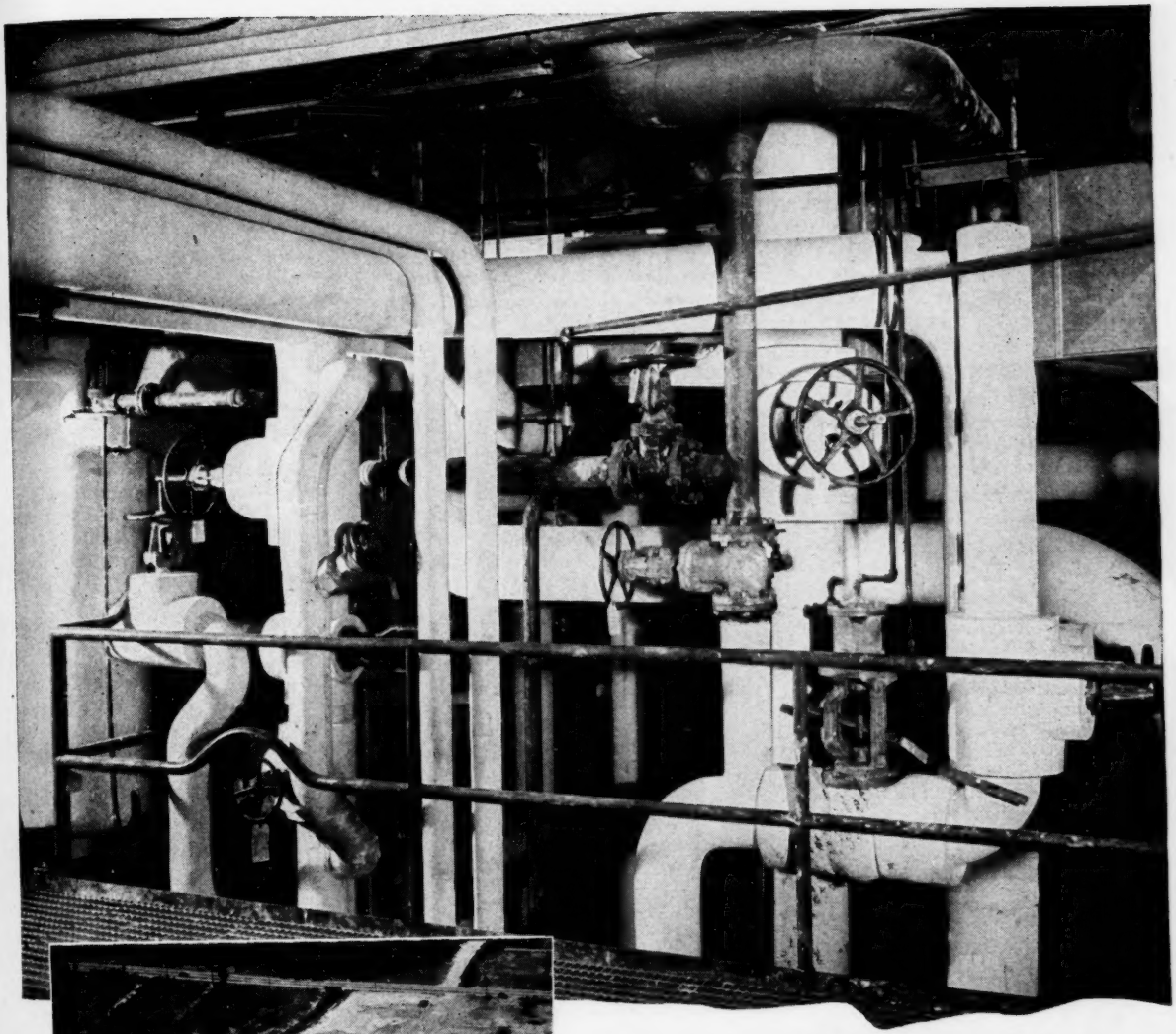
Our energy sources for tomorrow were reviewed in a most authoritative and comprehensive way by Ralph A. Sherman, supervisor Fuels Division, Battelle Memorial Institute. He discussed present trends in the burning of fuel.

Developments in synthesizing fuels and effects of these on the competitive positions of coal, oil and gas fuels were covered. Mr. Sherman expressed the opinion that "our proved reserves of petroleum and natural gas continue to appear to be enough for only a relatively short period in the face of an increasing demand. . . The day appears not too far distant when the conversion of coal to fluid fuels will be possible at a cost not too high for those uses for which the fluid fuels are best suited. As our basic energy source both of today and of tomorrow, coal will continue to afford man an increasing amount of energy for the building of his culture and for the growth of civilization."

Various methods of firing pulverized coal were shown in an unusual series of colored motion pictures produced and shown by Otto de Lorenzi, director of education, Combustion Engineering Co., Inc. He explained first the development and operation of the vertical fantail burner, the horizontal burner and the tangential burner of both fixed and tilting types. The photographs showed typical burners of each kind in operation. In one station equipped with tilting burners, the total steam temperature of 900 F was held within $\pm$ 3 F by this method, combined with proper operation of superheat by-pass dampers.

Warning that "we must subdue somewhat the hysteria for tearing up all the old blueprints" in power generation, C. G. A. Rosen, director of research, Caterpillar Tractor Co. described some Diesel developments of significance. These include the rise of the higher-speed, higher-capacity engine, reductions of fuel requirements, use of supercharging for the Diesel, new knowledge regarding burning of hydrocarbon-fuels, many improvements in mechanical design.

To reduce air pollution from small boiler plants, Parker A. Moe, consulting engineer, advocated proper smoke abatement ordinances, proper licensing of power plant engineers and firemen, sound engineering in the design and installation of equipment, proper use of appropriate dust collecting devices and fly-ash hoppers. He stated that in his opinion overfire air jets should be included on all solid fuel installations, no matter what type of stoker is involved. Proper installations and use of instruments and controls and smoke indica-



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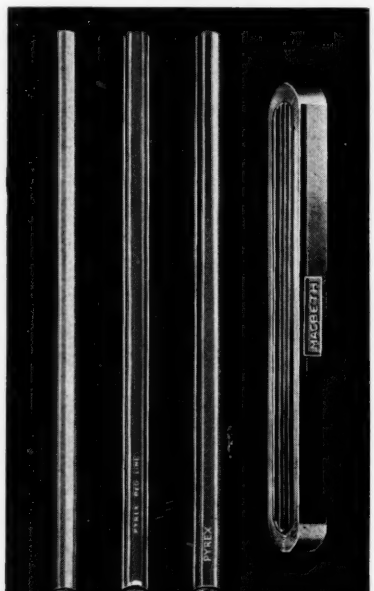
If more than ordinary visibility is desired, specify PYREX Red Line Gauge Glasses. • For general high pressure duty, PYREX High Pressure Gauge Glasses give you long service under the most severe operating conditions. • Where moderate temperatures and initial costs are the determining factors, CORNING Standard Gauge Glasses are recommended. • MACBETH Flat Gauge Glasses are designed for high steam pressures. Two types are available; *plain*, which are used in pairs with the water column enclosed between the two glasses, and *reflex* (made with vertical prisms), which are used singly with prisms adjacent to water column.



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tors also aid greatly in reducing dirt emission.

Heat Pumps—Air Conditioning

Because of the increasing interest in the heat pump, many studies are being made of its performance and particularly of the use of ground coils to supply the low-temperature heat required. Results of a study made for The Terra Temp Co., now planning to manufacture heat pump units commercially, were presented by R. A. Budenholzer of Armour Research Foundation, Illinois Institute of Technology. This study shows that the value that should be paid for electricity to compete with various fuels ranged from 0.69 cents to 1.68 cents per kwhr.

Pent-up demand for air conditioning equipment is now very large. In satisfying it much equipment will be needed, of which one item is the refrigeration compressor. Since Willis Carrier had discussed the centrifugal compressor for this service at the last conference, A. B. Newton, chief engineer, Airtemp Div., Chrysler Corp., covered the reciprocating type this year. Baseboard radiation developments, another new idea in residential climate conditioning were discussed by W. S. Harris of the University of Illinois, while the new field of panel heating with air was covered by H. F. Randolph, International Heater Co.

How's the Gas Turbine Doing?

Progress in development of the coal-fired gas turbine power plant was detailed most effectively by John I. Yellott, director of research, Locomotive Development Committee, who is developing such a plant for locomotive use. Further details of progress will be reported here and will be incorporated in Mr. Yellott's current series on the subject in POWER PLANT ENGINEERING.

Recent developments in the gas turbine by Brown Boveri were treated in detail by Paul R. Sidler, president Brown-Boveri Corp. (New York). Progress on construction of several large units for installation by his company in Europe and South America were reviewed essentially as given on page 122, March issue, POWER PLANT ENGINEERING. He then explained in detail a new device, the Comprex, a rotary pressure exchanger, recently developed by his company. It is extremely compact and its use permits the turbine to take in and work with gas heated to 1800 F, but with the rotor withstanding only 975 F, hence made of metals whose reliability in this temperature range is well known. The use of the Comprex in a locomotive unit also permits a theoretical increase in capacity of 80 per cent and an efficiency improvement of 4 per cent. However, some problems in control of the speed of the devices still remain to be worked out.

To show where the gas turbine will fit as a stationary power plant, a masterly technical and economic analysis was presented jointly by L. N. Rowley, managing editor and B. G. A. Skrotski, associate editor of *Power*. While ad-

mittedly based on considerable hypothetical data, this analysis showed how under present known cost conditions, for an assumed 10,000-kw power plant to serve an isolated load, operating costs of a gas turbine plant would be about 75 per cent of steam plant costs, investment costs would be 91 to 98 per cent of steam plant investment and since gas turbine costs abroad are reputed to be only 85 to 90 per cent of steam turbine costs, the gas turbine plant should produce cheaper power. Other calculations showed how, for a 10,000 kw plant to be added to a system with 100,000 kw capacity, gas turbine plant investment could be from 92 to 103 per cent of steam, would have lower operating cost and seems more favorable. This paper analyzed various methods of supplying process heat from the gas turbine plant.

Hydroelectric

In the hydroelectric field, Vincent Thieman, Wisconsin Public Service Corp., analyzed correlation of hydro and

Fig. 3. Speakers at session on Central Station Practice. Left to right: Charles H. Smoot, D. G. Reid (Chairman) and W. E. Glennon

steam plant operation; E. Robert de Luccia, chief, Bureau of Power, FPC, told about plans for co-ordination of hydroelectric and steam-electric power in the Missouri River basin.

Planning and construction of Keokuk hydroelectric plant on the Mississippi River in 1913 was at that time an outstanding achievement. Its subsequent development and the problems and experiences encountered in operating it up to the present were narrated by F. L. Mercer, plant manager, Union Electric Power Co.

Numerous papers on transmission, distribution and control of electric power were included in the program. Some of the data from these will be presented in future issues.

Statistics for the electric light and power (utility) industry were given by H. S. Bennion, managing director, Edison Electric Institute. His paper will be abstracted in the next issue. His data were supplemented by additional statistics presented in another paper by George L. Jorgensen, statistician, Commonwealth Edison Co.

Water problems are always a vital subject to power engineers. Carbon dioxide removal from water was discussed by H. E. Kittredge, Cochrane Corp., demineralized water by Lyle B. Porter, Illinois Water Treatment Co.;

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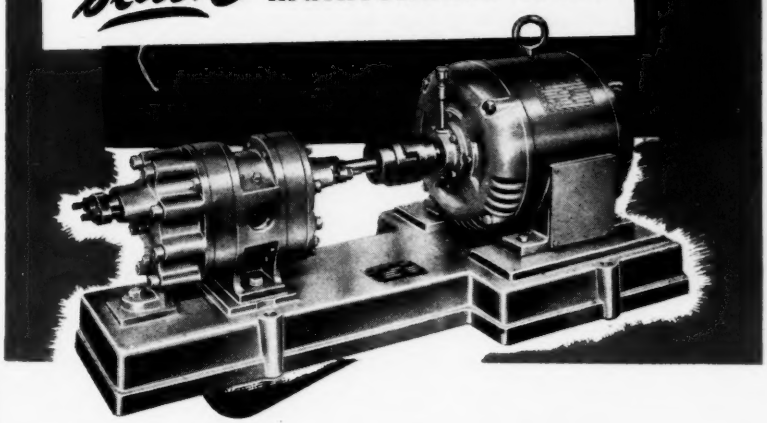

The high cost of maintenance crews plus increased competition make mechanical breakdowns more costly than ever before.

Sier-Bath employs "tool room" manufacturing methods to give Gearex Pumps closer tolerances and better fitting parts . . . the answer to pump maintenance problems. Exact rotor clearance is achieved by accurate timing gears and roller bushings. The result: maximum operating efficiency at high speeds. Non-contacting rotors cut wear. Vibrationless operation does away with costly foundations. Pulseless flow eliminates wasteful wear on attachments . . . they last longer and need less attention.

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CAPACITIES: 1-550 g.p.m.

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★ **Certified capacity—by actual test at The National Board of Boiler and Pressure Vessel Inspectors Laboratories . . . your warranty that this valve has the specified relieving capacity . . . your assurance of complete protection for the equipment served.**

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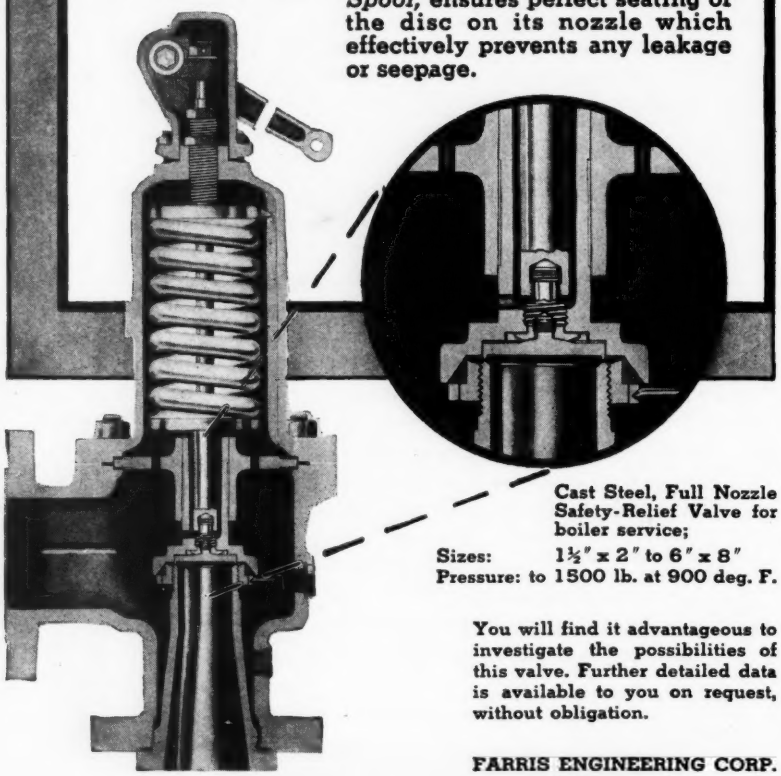

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Sizes: 1½″ x 2″ to 6″ x 8″
Pressure: to 1500 lb. at 900 deg. F.

You will find it advantageous to investigate the possibilities of this valve. Further detailed data is available to you on request, without obligation.

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and materials for modern feed pump construction by H. L. Ross, chief engineer, centrifugal pump department, Allis-Chalmers Mfg. Co. These will be treated more fully in future issues.

Power and Military Preparedness

At the "All Engineers" dinner Fleet Admiral William F. Halsey, USN, warned the conference that, in all our understandable eagerness for economy, we must avoid making a dangerous reduction in our military strength. Today, he said, the Navy's operating fleet is only 9 per cent of the ships we had at the close of the war. Economy does not consist in NOT spending but in getting the most for our money.

We must not create a Maginot Line mentality. Push-button warfare is still a long way off, for today we have little more than the push-button. Something more important is needed than preparedness in industry and adaptability of our planes and ships. That is: we must be strong in spirit, must maintain that inner strength we had during the war, if we are to be properly prepared for peace.

Complementing Admiral Halsey's ideas, Richard R. Deupree, executive chairman of the Army and Navy Munitions Board, and president of the Proctor & Gamble Co., described the work of the Board. It is charged by law with the responsibility of developing an industrial mobilization plan capable of being effectively and rapidly implemented at the first sign of danger of war.

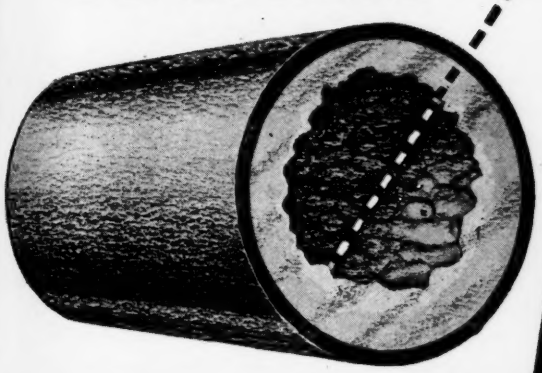
Going into specific details of what electric power means in any national security plan, John W. Swaren, research analyst, Industrial College of the Armed Forces, pointed out that in a future war, the United States will never again be able to organize its military and industrial might behind the fortifications of distance. Attack on us will doubtless be aimed at destroying or crippling our great electric generating stations—Grand Coulee, Philo, Powerton, Niagara and the like—or it might be on switching centers like East Hammond, Clinton or Charleroi substations. One of the greatest tactical errors of the Allies in World War II was the failure to destroy the German power systems. The General Staffs of all nations are now awake to the implications of electric power. They will not repeat that error.

The Engineer as a Citizen

Emphasis was placed by several speakers, in the general sessions, on the civic and social responsibilities of the engineer. At the Joint Conference luncheon with the ASME on Monday, March 31, Pearce Davis, Director of Business & Economics, Illinois Institute of Technology, reviewed the present economic situation, with employment, prices, income, production and other factors all at high levels, pointed out the unfavorable factors in the high public debt, lack of housing, inflationary effects of high prices. He showed how the net result is lower real income, concluded that the high prices hold a threat

(*Continued on page 166*)

For Pipe Line Protection



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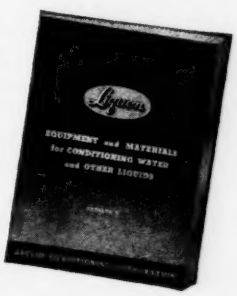
Write for Catalog G, describing the LIQUON Vacuum Deaerator and the many other different products and processes developed by LIQUON engineers to improve water quality. If your water supply has high hardness or alkalinity, or contains other impurities of any kind, consult these long-experienced water treatment specialists.



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1. Full herringbone driving gears for quiet, efficient, smooth transmission of power.
2. Full herringbone rotors for pumping only . . . no contact between rotors . . . no wear except from liquid pumped.
3. Extra-deep stuffing box with space for 6 to 8 rings and seal cage.
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6. Heavier body construction.
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REMEMBER, THERE IS NO SUBSTITUTE FOR A QUIMBY
Experiments are costly! Be sure it's a genuine ROTEX. Quimby has been making pumps exclusively since 1894.

QUIMBY PUMP DIVISION PORTER "Better Built" EQUIPMENT

H. K. PORTER COMPANY, Inc.
Quimby Pump Division
PITTSBURGH 22, PENNSYLVANIA
District Offices in Principal Cities

ENGINEERS' PREVIEW

FOR the past six years, Bausch & Lomb Optical Co. and Purdue University have carried out extensive research of industrial vision requirements for scientifically determining the eye skills neeessary for performing hundreds of jobs. Each job was analyzed and it was found that the patterns of visual requirements vary with each task. In other words, an individual may have a visual pattern entirely suitable for one job, but decidedly unsuitable for another. While this research was going on, engineers at Bausch & Lomb, designed the Ortho-Rater, incorporating 12 of the visual performance tests which had shown definite relationship to job performance, safety and health. With these comparatively simple charts, employees' visual performance can be measured at far and near distances, created optically within the instrument, of 26 feet and 13 inches respectively. Tests for depth perception, acuity or sharpness of visual perception, eye muscle balances, and color, determine individual vision characteristics.

★ ★ ★

THOSE WHO have had the opportunity to see the motion pictures of both the German and the American tests of rockets now being shown before various engineering bodies by Mr. Ruiz of General Electric Co., will pay more attention in the future, we hope, to the doings of one Buck Rogers in the comic strips. The science of rockets has been developing for a great many years, almost unknown to the general public and even to many engineers. And not all the development work was done by the Germans either. In this country, many years ago, Dr. Goddard began to study them and has done a great deal of the important work on them. The Germans, however, just let themselves go during the war and visualized the rocket as a substitute for heavy artillery. However, there is much more to the rocket than its use as a weapon, as you will be told by members of the American Rocket Society now affiliated with the ASME. Atmospheric research, for example, is going to be of the highest importance not only in the development of rockets themselves, but in radio, astronomy, radar and many other fields. It remained for World War II to produce rocket type projectiles and to make possible investigation almost 100 miles above the surface of the earth. Use of small spectrographs for installation in some of the rockets being tested at White Sands, New Mexico, will provide a great deal of scientific information of great value. For more details of this interesting subject, together with details of the spectrograph as made by Bausch & Lomb Optical Co., see the interesting article Rocket Spectrography by J. W. Forrest in *The Educational Focus* booklet, Fall 1946 issue, Vol. 17, No. 3.

★ ★ ★

CAST bakelite resin balls, designed originally for Army aircraft gun turret bearings, have met the closest dimensional tolerances, are light in weight, strong, weather-resistant, withstand temperature from —60 to +180 F.

AIR COMPRESSOR LUBRICATION

Solving AIR COMPRESSOR TROUBLES

Lubrication Engineer's Report:

"A mining company* in the Joplin area was having trouble with the unloading valve on an Angle Compound Air Compressor. They were also troubled with discharge valve breakage of the high pressure cylinder.

Case No. 1:

"The previous oil was replaced with Cities Service North Star Oil No. 5 and not a single instance of gumming or sticking or trouble of any kind with the unloading valve or discharge valve has been reported in over two years."

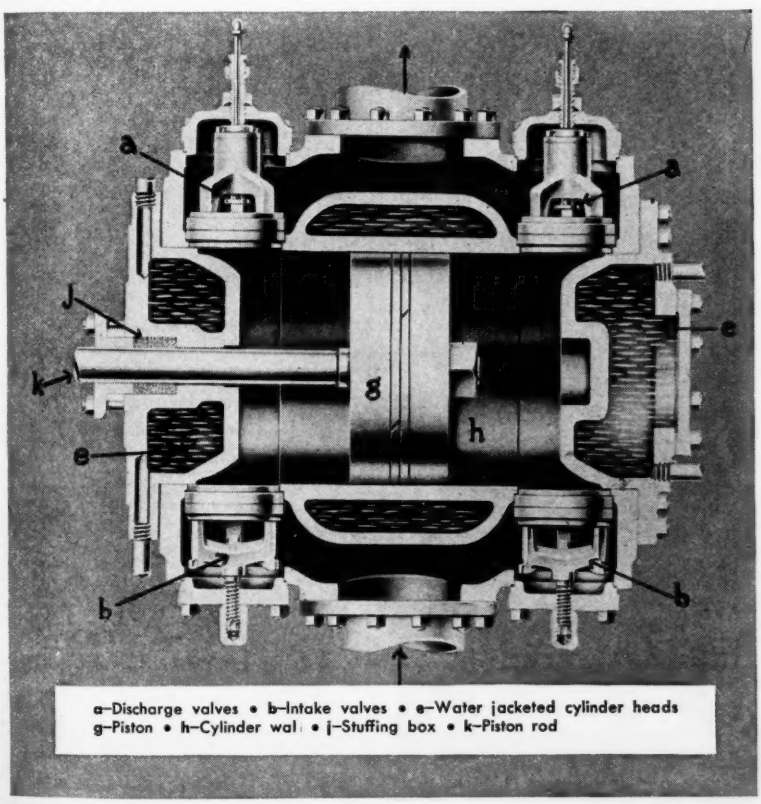
Case No. 2:

"A utility plant* in Springfield, Mo., uses compressed air from a single stage belt-driven air compressor in connection with overhauling jobs of the boilers in their plant. They are all of the water tube type and are overhauled at regular intervals. During these overhauls they need a constant supply of air. The unloading valve of this compressor would gum up to the extent that they would have to clean it about every other day when using a competitor's oil. I sent them a drum of Cities Service North Star Oil No. 5 about a year ago, and checked with their Chief Engineer last month. He tells me they haven't had to clean the unloading valve since putting in the North Star Oil."

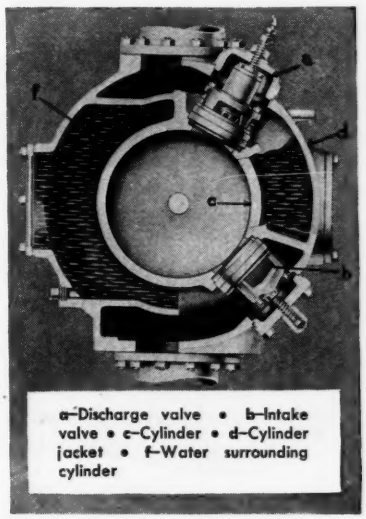
Case No. 3:

"We have lubricated a 1000 cubic foot two-stage air compressor in the Mid-Continent area for over three years. The customer* says that in using Cities Service North Star Oil No. 5 in this compressor he hasn't had any valve breakage and that carbon deposit on valves and seats has been down to practically nothing."

**Names on request.*



a–Discharge valves • b–Intake valves • e–Water jacketed cylinder heads g–Piston • h–Cylinder wall • j–Stuffing box • k–Piston rod



a–Discharge valve • b–Intake valve • c–Cylinder • d–Cylinder jacket • f–Water surrounding cylinder

Solving compressor operating problems has been Cities Service's special forte for years. A phone call or card to the Cities Service office nearest you will bring this engineering experience to *your* plant. There is no obligation. For useful information that every air compressor owner and operator should know, write for our free booklet, "Air Compressor Lubrication." Cities Service Oil Co., Sixty Wall Tower, New York 5, N. Y., Room 88.

Free Booklet:

Cities Service means Great Service

CITIES SERVICE

Cities Service Oil Co.
NEW YORK - CHICAGO

Arkansas Fuel Oil Co.
SHREVEPORT, LA.

MIDWEST POWER CONFERENCE

(*Continued from page 162*)

for the future and urged united effort to reduce them.

At the Tuesday luncheon, W. C. Johnson, vice-president, Allis-Chalmers Mfg. Co., told how the business man looks at labor. He reviewed the analyses of organizations like CED, showing that it was *possible* for this country to attain an economy based on $200,000,000,000 a year of gross national product and how since V-J Day, the strikes that have occurred have reduced that potentiality by hundreds of millions of dollars and incalculable value in time.

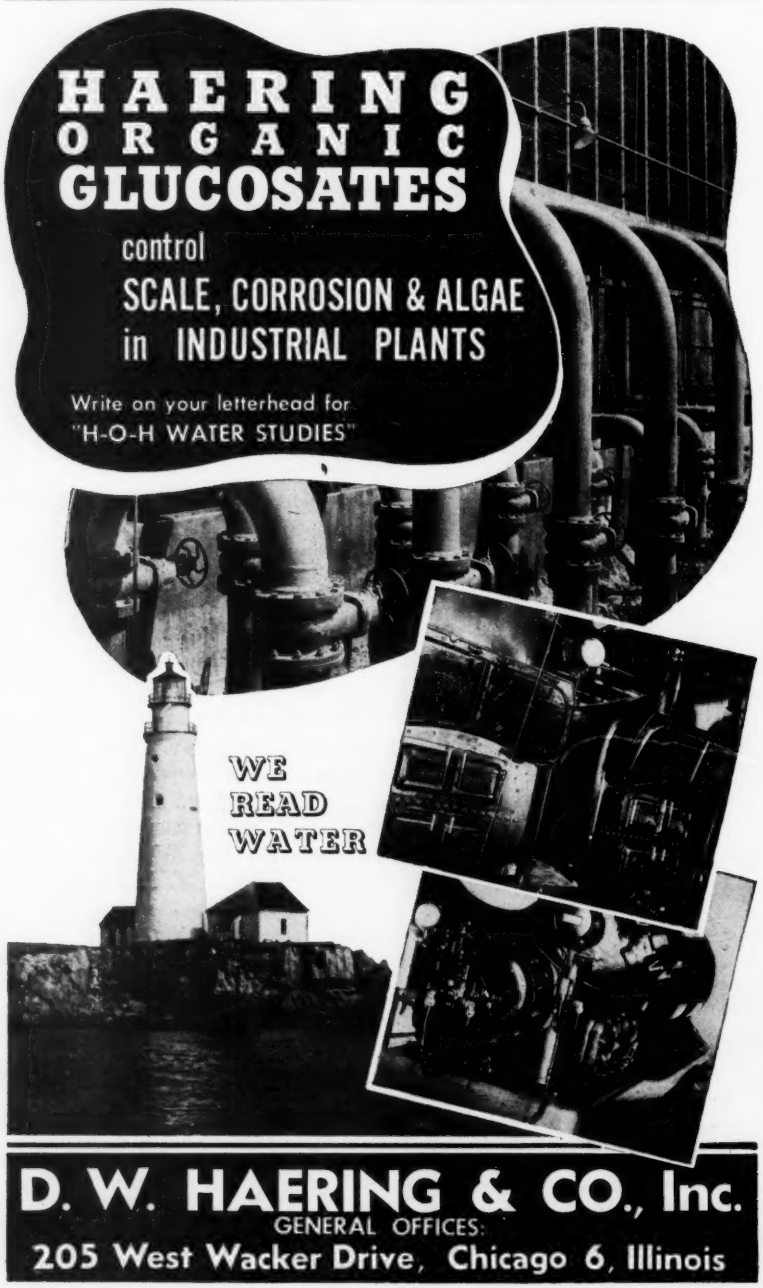
At a general session on April 2, the conference was addressed by Edward J. Kelly, mayor of Chicago, who is leaving the office this month after serving in it for 14 years. Mayor Kelly appealed to engineers to enter more broadly into civic affairs, pointing to the need in those affairs for the analytical type of thinking characteristic of the engineering mind.

Further emphasis was given to the engineer's civic responsibilities by Robert M. Gates, president of Air Preheater Corp., at the same meeting. Emphasizing the influence of our new scientific and technical powers in shrinking the size of the world, he urged engineers to rethink their responsibilities as citizens in a society confused and floundering in efforts to adjust itself to new power and responsibilities.

Fig. 4. Speakers at session on Small Power Plants. Left to right: Robert Krause, M. P. Cleghorn (Chairman) and Parker A. Moe

From a little different angle, Joseph D. Lohman, lecturer in sociology at the University of Chicago, traced the growth, in our system of specialization, of a *trained incapacity* to make intelligent judgments outside the range of our various vocations. A continuing liberal education as we pursue our specialized interests, he said, is an indispensable condition of democratic society.

George P. Torrence, president of Link-Belt Co., outlined how engineers can use the "Will It Work?" approach to public matters, asserting that proposed plans will not work if they are not right and conversely if they are not right, they won't work.



HELPFUL BULLETINS

(*Continued from page 52*)

self-priming water pump and other advantages of the saw. A 5-day free trial offer is also outlined in the bulletin. Descriptions of the blades which are used in the saw are included and excerpts from testimonials are given. Champion Mfg. Co.

47 **Bronze Pillow Blocks**—This 8-page bulletin describes the company's line of self-aligning, bronze pillow blocks and flange units. The greater proportion of the bulletin is devoted to tables of dimensions and dimensioned drawings of the units. A complete description of the overall features of the line of pillow blocks and flange units is presented on the inside front cover. Anti-Friction Bearings Co.

48 **Magnetic Crane Controls**—5 types of magnetic crane controls for handling any type of load are described in this 20-page booklet B-3853. It contains descriptive information, wiring diagrams, performance curves and application guide to aid in selecting the type of a-c control best suited to any application. Special attention is given to the reactor system, a new development particularly applicable where spotting of the load is important. Installation photographs are included. Westinghouse Electric Corp.

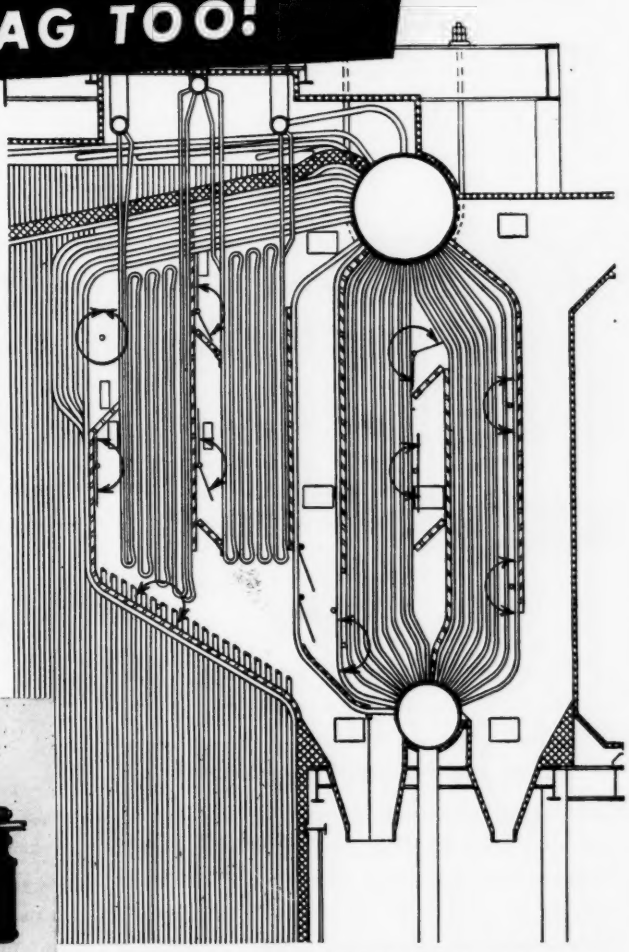
49 **Swimming Pool Equipment**—This 8-page bulletin describes the company's complete line of water filtering and treatment equipment for swimming pool installations. Information is provided which will enable the engineer, builder or architect to construct and maintain a sanitary, hygienically safe pool. General construction of the filters is included and detailed descriptions of filtering material, coagulant feed and valving is included. Operation of the system is covered in another section of the booklet. A listing of the pool accessories which the company can furnish is included. Standard pool sizes and a sectional dimension drawing will assist in the construction of any type of pool. Graver Tank & Mfg. Co.

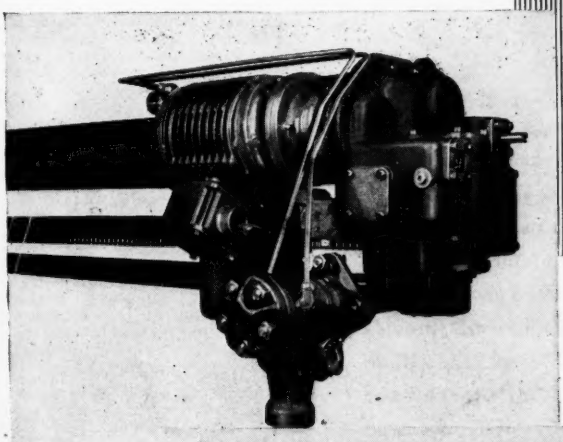
50 **Files**—"There's a Swiss file for every specific purpose" is the title of this 24 page tabloid catalog. It is described as an extremely convenient guide and reference booklet and it lists 3566 patterns, sizes and cuts of hand and machine files and rifflers. In addition to this large number of standard files, numerous special files bring the line up to more than 5000 different patterns, sizes and cuts. Grobet File Co. of America, Inc.

VULCAN Soot Blowers

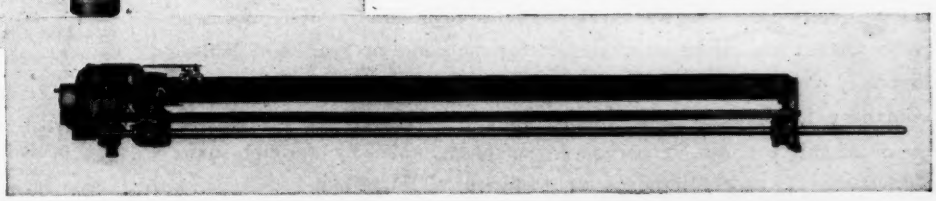
REMOVE SLAG TOO!

Vulcan Soot Blowers and Deslaggers were selected for difficult cleaning jobs in the 120,000 lb. per hr. Foster Wheeler steam generators installed for the Staten Island Edison Company. Efficient combustion of pulverized coal, high pressure and high final steam temperature make high gas temperatures unavoidable. Slag deposits are thoroughly removed from screen tubes and superheater with Vulcan T-2 retractable soot blowers. Boiler and superheater tubes are kept free from soot by automatic valved head Vulcan soot blowers. Years of effective cleaning and low maintenance have taught engineers and operators to specify Vulcan on high efficiency units.





Below: Vulcan model T-2 retractable soot blower for removing soot and slag in high temperature gas zones. One electric motor extends the soot blowing element into the boiler, and another continuously rotates the soot blowing element while it is being extended and retracted. The steam valve opens automatically as soon as the nozzles clear the side wall and closes automatically when the element is retracted.



Above: Close up of T-2 operating mechanism.

VULCAN SOOT BLOWER CORPORATION

Du Bois, Pennsylvania

CATALOG LIBRARY

This monthly list of the latest standard catalogs and bulletins is designed to aid the engineer in maintaining his permanent catalog file of engineering data. The items listed, unlike those under Helpful Bulletins, will appear each month except for additions and deletions dictated by space requirement or by the manufacturers issuing the bulletins. Use the Helpful Bulletins coupon in requesting these copies.

BOILERS

51 **Steam Generators**—Catalog almost completely devoted to cross-sectional drawings with accompanying listing of principal data of typical installations in rubber companies, steel works, sugar refineries, municipal plants, etc. Details of furnace water wall construction on inside back cover; 16 pages. Henry Vogt Machine Co., Inc.

52 **Double-Pass Boilers**—Bulletin RM-1 (6th edition); illustrates and describes this line of riveted or welded double-pass steel firebox boilers. Three full pages of dimensions, ratings and other details including dimensioned flue diagrams; 8 pages. The Brownell Co.

53 **Boilers, Burners, Accessories**—bulletin GC-10; condensed catalog of regular products for stationary power plants. Each class of equipment summarized and illustrated. Well illustrated with line drawings and photographs. Illustrations accompanied by brief descriptions; 12 pages. Combustion Engineering Co., Inc.

54 **Standardized Boilers**—Bulletin 746; 4 page bulletin presenting construction and operation information and ordering specifications for this company's Type M boilers. Bulletin illustrated, presents table of measurement and data. Springfield Boiler Co.

55 **Steam Generators**—Presents reasons for high efficiency; shows brief case histories of plants. Results of tests by independent authorities and "Facts You Should Know About Steam Generating Units." Ratings, dimensions and other data presented. Springfield Boiler Co.

56 **Steam Generator**—Bulletin 119; company's Type S steam generator described and features of construction are pointed out. Folder well illustrated and dimensioned drawing and table of dimensions and sizes given. Union Iron Works.

PRIME MOVERS

57 **Axial Flow Impulse Turbine**—Bulletin S-107; six types described; data for estimates; applications; types, casings; wheels and blades; shafts, nozzles and bearings; overspeed stop and other governor features; lubrication; 8 pages. Terry Steam Turbine Co.

58 **Multi-Stage Turbine**—Bulletin SR-114; Casing, lagging, wheels and blades; shafts, nozzles, bearings; governors; speed changer or synchronizer; governor valve and steam strainer; lubrication; general; 10 pages. The Terry Steam Turbine Co.

59 **Turbines, Pumps, Products**—This 24-page catalog covers the company's complete line of products from steam turbines to flexible couplings. Every product is discussed from the design and operation angles and the discussion is heightened in interest by the inclusion of many excellent photographs. Other products discussed are helical gears, centrifugal pumps, multistage pumps, screw pumps, blowers, compressors and speed reducers. De Laval Steam Turbine Co.

60 **Turbine Cleaning Manual**—This 20-page bulletin covers the step-by-step solvent and manual cleaning of turbines from the inspection and preliminary cleaning to draining and final inspection. The cleaning of bearings and governor, installation of filter unit, circulation of cleaning solvent, and displacement of cleaning oil with new lubricating oil are steps which are covered briefly but clearly. Shell Oil Company, Inc.

61 **Steam Engines**—Bulletin No. 306; Engineering data; tabular material, descriptions; 8 pages. Troy Engine & Machine Co.

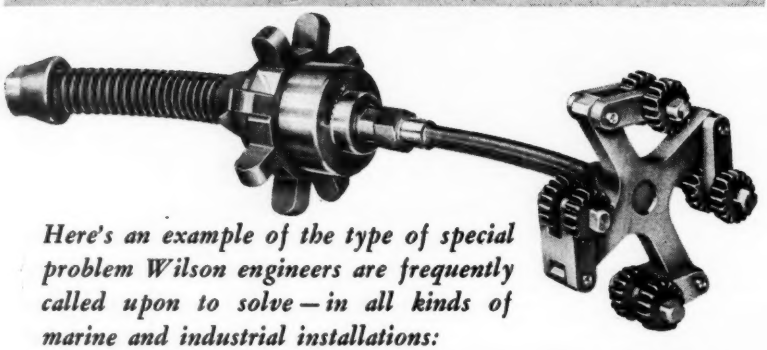
62 **Generating Sets**—Bulletin No. 108; General descriptions, typical installations, engineering data tables, details of construction, completely illustrated; 24 pages. Troy Engine & Machine Co.

63 **Stationary Diesel Engines**—Dependability, adaptability of Diesel power described and applications pointed out. Its economical and simple design is stressed. Advantages of company's equipment brought out; exceptionally well illustrated; 24 pages. Enterprise Engine and Foundry Co.

ELECTRICAL

64 **Oil Circuit Breakers**—Bulletin 71B-6421 describes Unitop oil circuit breaker; ratings from 15 to 46 kv, 500,000

DOUBLE TROUBLE
cleared up with this Wilson Cleaner in this piping installation



Here's an example of the type of special problem Wilson engineers are frequently called upon to solve—in all kinds of marine and industrial installations:

Mill scale, resulting from stress relieving after welding, had to be removed from a series of steel pipes varying in size from 2½" to 10" O.D.—ordinarily an easy job. In this case, however, "double trouble" was encountered. Multiple bends with radii as short as 4 times the pipe diameter had to be negotiated—and all possibility of marring the interior tube surface had to be eliminated. Specially engineered Wilson Tube Cleaning Equipment made quick work of this problem. It not only negotiated the short bends successfully, but removed all the scale, leaving the tube walls smooth and clean! Whether yours is an ordinary tube cleaning problem requiring standard equipment or an unusual problem like the one described above, you can be sure that Wilson will provide you with the equipment that will do *your* job faster, more thoroughly and more economically. Why not send for the name of your local Wilson representative? He is always ready to help you find the way to greater operating economy through more efficient tube cleaning.

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THRUST

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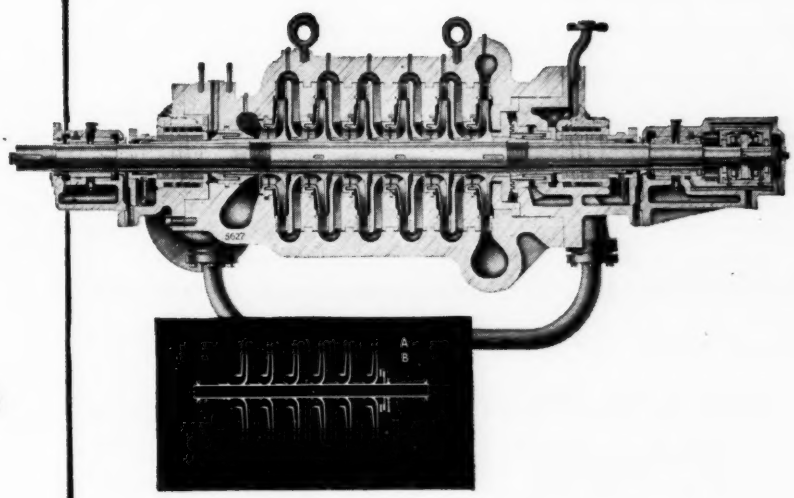
BALANCED



The exceptionally satisfactory performance of De Laval high pressure boiler feed pumps over many years is due, in no small measure, to the De Laval Automatic Hydraulic balancing arrangement. With this hydraulic balance, all thrust is automatically brought to a state of perfect equilibrium, the functioning of the device being unaffected by wear, load or other variables.

How the thrust is balanced

Any unbalanced thrust causes the rotor to shift axially, thus regulating flow through clearance A, thereby controlling pressure against balancing disc B and thus automatically returning the pump to a state of perfect balance.

Send for Catalog B-5-A describing De Laval multistage, single suction pumps for high pressure service.

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to 1,500,000 kva interrupting capacity. Well illustrated. Allis-Chalmers Mfg. Co.

65 **Generating, Substation Equipment**—Bulletin 25B6150 titled "More Power to U.S.A." 32 pages; sketches coverage of the company's equipment from hydro and steam turbines to switchgear and circuit breakers. Unusually well illustrated. Allis-Chalmers Mfg. Co.

AUXILIARIES, ACCESSORIES

66 **Strainers and Separators**—Bulletin 46-50; describes complete line of company's strainers and separators. Dimensioned drawings and photographs; tables of sizes and complete description of applications, operation and design; 16 pages. American District Steam Co.

67 **Atomizing Deaerators**—Bulletin 4160; 3 color drawing illustrates description of principle of operation. Advantages of deaerators are described and illustrated; marine deaerators also covered; 20 pages. Cochrane Corp.

68 **Steam Condensers** — Bulletin 1461 "Steam Condensers"; exceptionally well illustrated with line drawings, charts and photographs. Large proportion of the catalog devoted to engineering information such as calculations of required surface, atmospheric relief valve sizes, tube characteristics, free dry air leakage, pressure-temperature conversion tables and tables of logarithms; 46 pages. C. H. Wheeler Mfg. Co.

69 **Condensate Return System**—Description of operation and possible savings accompanied by line diagram and description of how "Jet-Loop" works; typical installation pictured and described. Drawings and text show proven results from experience of users. 2 page spread of drawings and table of dimensions; 16 pages. Cochrane Corp.

70 **Low Pressure Evaporators**—Description of L. P. evaporators; types of evaporator plants, listing of advantages of L. P. submerged tube evaporators. Line diagrams illustrate principles brought out in descriptions. Typical installations are considered and analyzed; 12 pages. Condenser Service and Engineering Co., Inc.

71 **Power and Industrial Equipment**—Bulletin Q-12; describes and illustrates company's equipment for power and industrial use—steam turbines, motors, generators, feedwater heaters, turbochargers, steam jet ejectors, centrifugal blowers. Exceptionally well illustrated; 20 pages. Elliott Co.

72 **Heat Exchanger**—This new bulletin describes the company's Twin G-Fin Section; Bulletin 1614; section characterized as universal heat exchanger. Bulletin tabulates 21 features and corresponding advantages, describes design and construction. Installation views shown, field reports included; 16 pages. The Griscom-Russell Co.

73 **Evaporators**—Bulletin 364 describes, illustrates evaporators for various capacities and pressures; contains sections of special interest to plant engineers and executives; includes explanation of functions of evaporators, benefits obtained by their use; different types of evaporating systems and their association with plant heat balance. 26 pages. The Griscom-Russell Co.

74 **Soot Blowers**—Bulletin F45; soot blowers in general are described. Description and operation of units, materials and specifications and other pertinent information is presented; tables of steam consumption, boiler efficiency, fuel saving chart; boiler cross-sections with blower locations indicated thereon and installation drawings and data are included; 10 pages. Marion Machine, Foundry & Supply Co.

75 **Water Heater Capacity Ratings**—14 tables are included in this ratings booklet showing capacity ratings per hour for temperature rises of from 20 deg (50 to 70 deg) up to and including ratings for a 150 F temperature rise (50 to 200 F). Table No. 15 presents the rate of flow of steam through pipes with steam from an initial gage pressure of one pound up to 150 psi. Marion Machine, Foundry and Supply Co.

76 **Heat Exchangers, Preheaters, Condensers**—A series of seven catalog sheets deal with various types of heat transfer equipment such as surface condensers, steam jet ejectors, heat exchangers, heaters and preheaters and coolers. Each of the sheets is well illustrated. Ross Heater & Mfg. Co., Inc.

77 **Air Ejectors**—Bulletin M-300 and M-301; what they do; types, blueprint type drawings, tables of sizes, manufacturing facilities and equipment; total 16 pages. The Lummus Co.

78 **Coal Weighing Scales**—Description; outstanding features, specifications, line drawings, photos; 4 pages. Beaumont Birch Co.

79 **Rack and Pinion Gates for Coal and Ashes**—Ball-Bearing, dust-tight features; photos, specifications, drawings, tables of dimensions; 4 pages. Beaumont Birch Co.

80 **Steam Specialties** — Collection of folders; steam trap, air trap, reducing valves, classes E, B and H pump governors, automatic boiler feedwater controller; parts and unit list prices;

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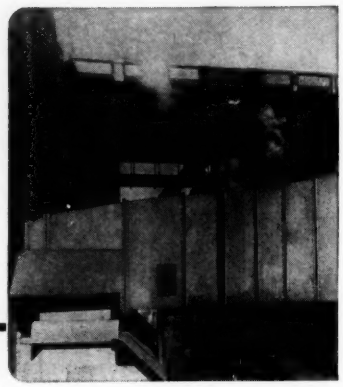

For a coating that will stand up, even under sudden changes of temperature, and hold its own against smoke and acid fumes, choose Bitumastic Hi-Heat Gray.

Its base of highly refined coal tar pitch gives it toughness to resist corrosion. Metallic powders (zinc and aluminum) are added to "fuse" under high temperatures and bond with the metal.

Hi-Heat Gray is a protective coating with a pleasing gray aluminum finish. When applied at the rate of 450 sq. ft. per gallon, one coat does the job. Life of the coat varies with conditions, but it is consistently longer than you will get from ordinary paints that do not have the tough, coal tar base.

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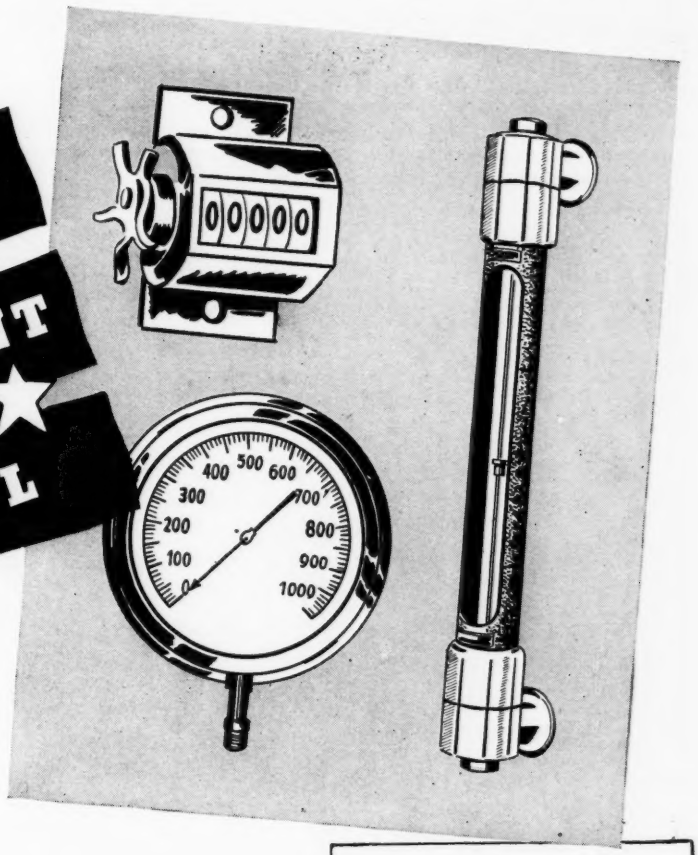

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Plan now, while wide selections are still available, to pick up needed instruments. Write, wire, phone or visit your nearest WAA office to inspect and purchase. Make sure, too, that your name is on the Instrument Mailing Lists of other nearby WAA offices. Investigate Fixed Price Sale; also ask for Sealed Bid offerings now being mailed regularly to interested firms.

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descriptions; illustrations; tables of capacities. The C. E. Squires Co.

81 **Deaeration**—Data book; No. N-15 gives reasons for and principles of deaeration; cold water deaeration; tabular drawing and chart material presented; well illustrated; 20 pages. Elliott Co.

82 **Power Plant, Industrial Process Equipment**—Steam turbines, turbine generators; mechanical drive turbines; motors and generators; feed-water heaters and deaerators; condensers and auxiliaries; steam jet ejectors, centrifugal blowers; turbochargers for diesels; accessories and tube cleaners; completely illustrated; 20 pages. Elliott Company.

83 **How to Choose a Steam Trap**—Trap selection, trap rating, trap capacity factors, individual trapping, determining lift; traps for unit heaters, pipe coils, fan system heating surfaces, steam jacketed kettles, autoclaves, laundry equipment, paper makers, etc.; installation, operation, maintenance, instructions; specifications and capacities; corrosive service; 42 pages. The V. D. Anderson Co.

84 **Coal Pulverizers**—4-page bulletin covers pertinent points of construction of direct-connected pulverizer. Well illustrated; operating advantages presented. The Strong-Scott Mfg. Co.

WATER TREATMENT

85 **Index for Calcium Carbonate**—Reprint of paper by John W. Ryznar; tables and charts; 16 pages. National Aluminate Corp.

86 **Boiler Feedwater Q & A**—Bulletin 30; 102 questions and answers on various problems of boiler feedwater; 16 pages. National Aluminate Corp.

87 **Water Treatment**—Scale and corrosion control in potable water supply; reprinted paper presented by Hanlon, Steffen, Rohlich and Kessler; 12 pages. National Aluminate Corp.

88 **Water Conditioning Service**—"The 6 Fundamentals of Betz Water Conditioning Service" illustrates and describes how this company extends a supervisory service for boiler water conditioning. Booklet shows complete operation of these 6 steps; 16 pages. W. H. & L. D. Betz.

89 **Water Softeners**—Bulletin 607; benefits and economies of soft water; typical applications; how it works; types; design and features; backwash and brine rinse reguators; how to modernize present softener; aerators, degasitors, chemical feed systems, chemicals; 20 pages. Elgin Softener Corp.

90 **Softener Handbook**—Manual, semi- and full-automatic zeolite water softeners are covered in Bulletin 315. Water softener plant is discussed in the first section and operating cycles and plant supervision is next considered. The third section is "Selecting Manual or Automatic Equipment"; this is accompanied by a table of comparison data. Graver Tank & Mfg. Co., Inc.

91 **Sludge Reactivator**—Illustrated booklet, 8 pages, fully explains the principle of upward sludge filtration and describes its adaptability to industrial and municipal water supplies. Charts, flow diagrams and cut-away drawings show clearly how equipment softens and clarifies raw water, materially reduces reaction time and provides, in many cases, a water that is suitable for process work without further treatment. Graver Tank & Mfg. Co., Inc.

92 **Hot Process Water Treatment**—Form 326 is a case study bulletin; covers results of an installation of the company's hot process equipment at Kankakee Ordnance Plant. System was designed to provide 60,000 gph of properly conditioned water, free from hardness, scale forming minerals and corrosive gases. Graver Tank & Mfg Co., Inc.

93 **Water Treatment**—Control of Fouling Organisms in Fresh and Salt Water, by John G. Dobson. Life history of these organisms; method of control. Wallace & Tiernan Products, Inc.

94 **Industrial Water Treatment**—Microbiological Control of and Through Industrial Waters; spot summaries of improvement of process efficiency and product quality by proper sterilization. Wallace and Tiernan Products, Inc.

95 **Condenser Water Treatment**—Chlorination of Condenser Cooling Water, by R. B. Martin; important considerations in chemical treatment of cooling water circuits. Wallace & Tiernan Products, Inc.

96 **Water Treatment**—Chlorine Destroys Ammonia, by A. E. Griffin. Gives data on use of chlorine for elimination of ammonia from boiler feed water. Wallace & Tiernan Products, Inc.

97 **Clarifying and Softening Water**—Eight-page catalog "Reactivator for Clarifying and Softening Water by Upward Sludge Filtration." First part of the booklet tells how the reactivator works and how the sludge blanket is kept in control so as not to flow out with the clarified water. Line diagrams illustrate the principle of operation. Graver Tank & Mfg. Co., Inc.

98 **Feed Water Treatment**—This four-page folder tells how the company's

full steam ahead with "NO-SLUDGE"

When too much fuel oil is consumed in relation to the power output—look for sludge at the bottom of the tank.

SLUDGE not only cuts down the B.T.U. output, but generally retards over-all boiler efficiency.

"NO-SLUDGE" Fuel Oil Treatment activates B.T.U.'s by putting sludge deposits into suspension, improves combustion, keeps burner nozzles clean, and eliminates rust and corrosion.

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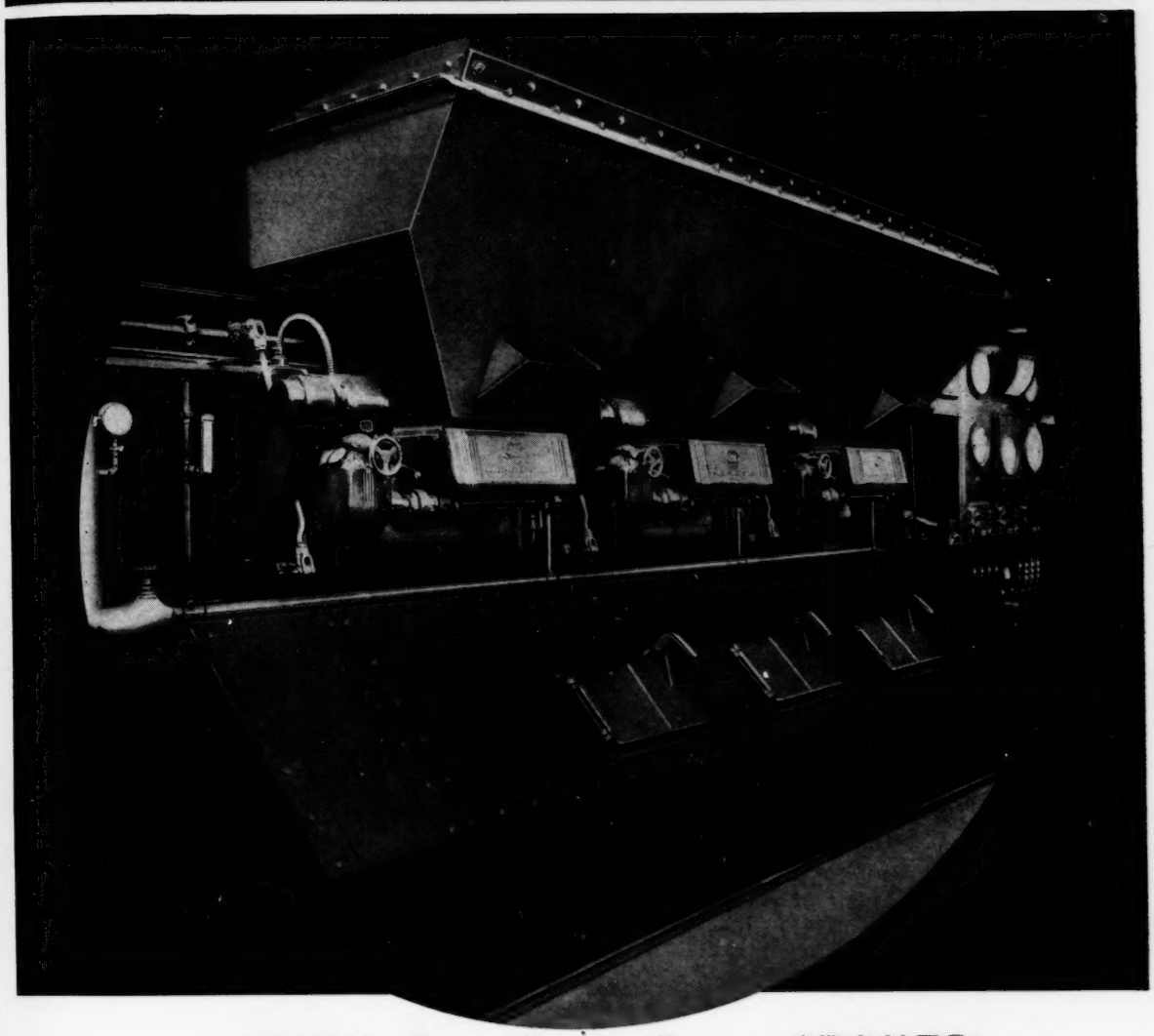

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Proof of the high efficiency of the NEW *Bros* Travl-Spred Stoker is in the ashes. Low in carbon, with almost no clinkers, ash falling from the traveling grate indicates complete consumption of even the slowest burning coals.

A zoned grate, with a generous burn-off area, assures the correct volume of air through the varying depths of the ash bed. The *Bros* Tuyere type grate meters air through openings below the fuel line at low velocity to eliminate fly ash and disrupted fuel bed. Individual tuyere units with cooling ribs mean longer life free from warping.

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engineering applied to boiler feed water problems can result in savings. It tells of the different procedures and presents diagrams of equipment arrangement. Typical installations in dairy, cosmetic, aircraft, laundry, and other plants are pictured. Illinois Water Treatment Co.

99 **Chemical Feeding and Proportioning**—Bulletins 1100 and 1713A; use of adjustable chemical feeder for water treating, sewage, chemical processes, petroleum; plan and sectional diagrams; descriptions; photos; general specifications; 2-page table of capacity schedules; list of chemicals handled; accessories; drawings of boiler water conditioning systems; 5-page description of method of automatic intermittent feed of conditioning chemicals direct to the boilers; 20 pages. Proportioneers, Inc.

100 **Automatic Proportioning**—Bulletin 1200, 28 pages. Handy reference book containing wealth of information on automatic flow responsive equipment and methods in continuous process operation. Photos of equipment and installation are supplemented by many flow diagrams and detail drawings. Complicated subject made exceptionally clear and understandable by careful arrangement and two-color diagrams. Proportioneers, Inc.

101 **Chemical Proportioning Equipment**—Bulletin 1714 covers chemical proportioning equipment for sea-going service. Two units—for high or low pressure—are described fully. Tabular material assists in the description. Proportioneers, Inc.

102 **Water Conditioning Instruction Booklet**—Bulletin 28X6385 was written especially for guidance of power plant operators. It touches upon importance of feedwater control, care of testing equipment, obtaining samples, test procedures. Handy reference tables given as aid to reporting results. Allis-Chalmers Mfg. Co.

103 **Complete Water Conditioning Service**—This four-page bulletin describes this company's complete water conditioning service—analysis, design, fabrication, installation and maintenance of water treating equipment. Typical installations are pictured and brief sketches of the men behind the service are given. Graver Tank & Mfg. Co., Inc.

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High grade gas, by-product and steam coal from Wise County, Va., on the Interstate Railroad.

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COATINGS, TREATMENT

104 **Protective Coatings**—4-page folder 844-246 describes Bitumastic Hi-Heat Gray, a specialized industrial protective coating which is said to resist corrosion and temperature up to 1200 F. The folder is in 2 colors and contains several photographs of equipment on which Bitumastic has been applied. It also gives a list of uses for the material and a chart giving its characteristics. Wailes Dove-Hermiston Corp.

105 **Fuel Oil Treatment**—A 4-page bulletin, telling about the company's treatment for fuel oil called "No Sludge." Advantages of using the treatment such as stepping up efficiency and reducing operating costs are explained. A list of dosages and applications is also given. A free test offer of the treatment is explained on the first page of the bulletin. Dominion Chemical Co., Inc.

106 **Flue Cleaner**—The company's soot and fire scale removing compound is described in this six-page folder. Results obtained from the use of this compound are described in the first part of the folder and then a list of the things which the company guarantees the material will accomplish are listed. Tables of dosage are presented and another table shows losses due to soot and fire scale. Dominion Chemical Co., Inc.

107 **Boiler Rust Treatment**—This four-page bulletin describes the company's "Rustoff" chemical which is said to "build resistance to rust and scale corroded and congested pipes." The bulletin tells how the treatment works and what results may be expected from its use. A brief description of the company's service department is included. Dominion Chemical Co., Inc.

108 **Fuel Oil Treatment**—Several bulletins have recently been announced by this company describing completely the application and effect of its fuel oil treatment compound and Diesel engine solvents. Wilcolene Mfg. Co.

HEATING, COOLING

109 **Cooling, Heating, Air Conditioning**—Collection of bulletins; installation, design, construction data, capacity ranges, condensed physical data; numerous photos of installations, full page color diagrams of flow of air, compressed air, water, water spray, etc.; 74 pages. Niagara Blower Co.

INSULATION

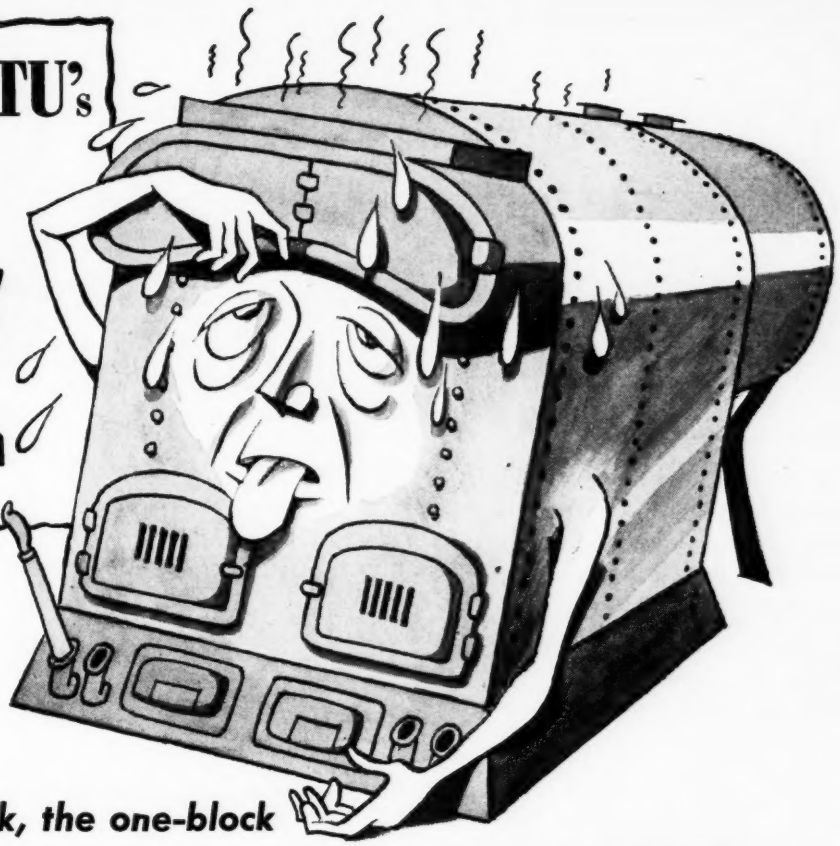
110 **Industrial Insulations**—Block, blanket insulations; pipe covering; new pressure coverings; insulating cement; felt; Koldboard; fill insulation; diatomaceous earth products; uses, specifications, applications, preparation; charts; photos; list prices; 26 pages. Baldwin-Hill Co.

111 **Insulating Cement**—Ease of application; efficiency; ease of maintenance; application recommendations; heat loss calculations; 4 pages. Baldwin-Hill Co.

STOKERS

112 **Air-Cooled Stoker**—Catalog R-A; features of construction; how timing device works; installation drawings,

wayward BTU's cured in ONE application



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ash discharge, air cooling features; features of front end driving mechanism; engineering data tables; 20 tables. American Engineering Co.

113 **Water-Cooled Stoker**—Catalog W; drawings aof installations; features; furnace views; 8 pages. American Engineering Co.

114 **Spreader Stoker** — Installation views; features of various parts; cross-sectional view of furnace with installation; listed features; 8 pages. American Engineering Co.

115 **Pneumatic Spreader Stoker**—Three-fold booklet on the inner pages of which there are 30 spirally-bound vertical pages which fold back to tell the story of the stoker, installation, features, construction, principles, engineering, types and models, typical installations; well illustrated; 33 pages. Iron Fireman Mfg. Co.

116 **Poweram Stoker**—Bulletin 7121; essentials of successful stoker; fuel control, fuel conveying, fan capacity, controls, installation; illustrations; 18 pages. Iron Fireman Mfg. Co.

117 **Coal Reference Bulletin**—Bulletin 8, Underfeed Stoker Firing. Bulletin covers factors involved in selection of multiple retort stokers, principles, design data and drawings of typical installations; 6 pages. Fairmont Coal Bureau.

118 **Stoker Firing Operation**—Single Retort Underfeed Stoker Firing is the subject of Bulletin Number 9 issued by this Bureau. It is a complete analysis of the advantages of the single retort stoker in the smaller plants. Types of this stoker are described and principles of operation are outlined. Fairmont Coal Bureau.

OIL, GAS BURNERS

119 **Wide Range Oil Burning System**—Bulletin 109; How the system operates; control, drawings; 4 pages. Peabody Engineering Corp.

120 **Oil Burners**—Bulletin 108; Two types of oil burners, A and H; air registers, oil atomizers, drawings; 4 pages. Peabody Engineering Corp.

121 **Gas Burners**—Bulletin 203; description of A and H gas burners; cross-sectional diagram; photos of atomizers; 4 pages. Peabody Engineering Corp.

OIL, LUBRICATION

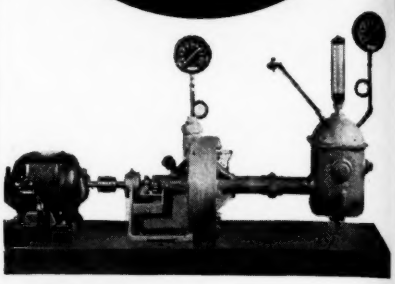
122 **Lubrication Recommendations** — Special oils for diesels and heavy-duty gasoline engines; facts about oil; tables of recommended oils for various models; 18 pages. Standard Oil Company of California.

123 **Cutting Fluids**—Facts about cutting fluids; machine tool operations; fundamentals of cutting; how to apply; metallic cutting tools; tabular material; show practices; 50 pages. Standard Oil Company of California.

124 **Diesel Operation**—Relation of fuels and lubricants in the operating efficiency in the diesel engine; diesel fundamentals; maintenance; lubrication and fuels; supercharging; selection and classification of fuels; fuel injection maintenance; improving cleanliness; tabular material, charts, formulas; 114 pages. The Texas Co.

125 **Engineers Report on Oil**—Engine tests, laboratory tests, effects on engines, bearing corrosion, actual service data, filter clogging, service experience; well illustrated with photos and charts; 42 pages. Standard Oil Company of California.

Here's how you save by handling Condensate the *direct* Returnal WAY



SAVES FUEL

Because the RETURNAL System returns each pound of condensate to the boiler as fast as formed—also at high pressure and temperature and without flash steam loss from vented receiver—it cuts down boiler load and saves fuel, water and water treatment materials. Fuel savings alone usually exceeds 25%.

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Many RETURNAL Systems have been running 6 years without expense other than electricity, lubrication and packing. Often, however, the largest saving in maintenance is with traps, which are no longer necessary. Moreover, when flooding occurs in any steam trap system much time and productivity can be lost before it is determined which trap is causing the trouble.

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Because the RETURNAL System assures hotter steam heated units, no waiting for traps to fill up and dump-dry, hot steam is made available everywhere all the time. Remember that it takes only a small increase in production to be worth more, in dollars and cents, than a comparatively large saving in fuel.
Now, while fuel is expensive and increased production is worth big money is a good time to check on your condensate return methods—see where and how the improved RETURNAL System can pay back its cost in a few months, then continue to pay dividends for years to come.

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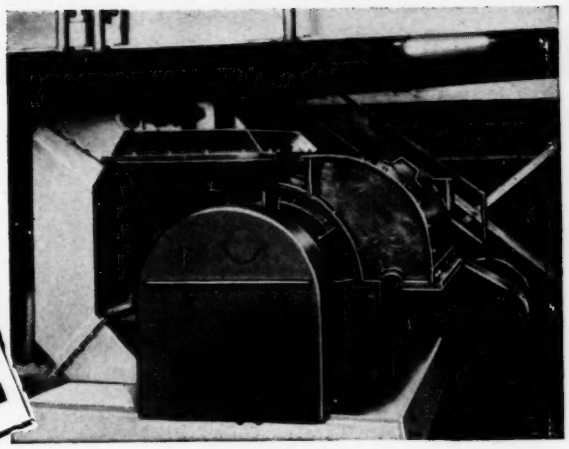
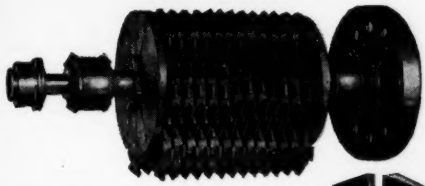
for a low cost coal crushing operation that's COMPACT AND COMPLETE



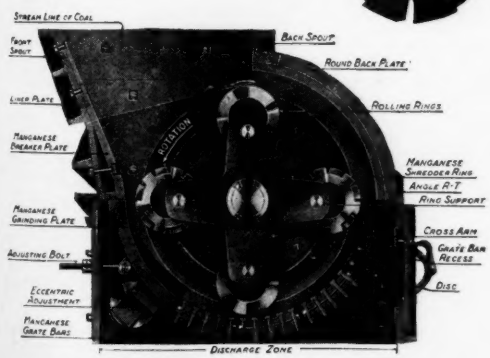
AMERICAN ROLLING RING CRUSHERS

–installed in minimum headroom as a complete high capacity coal preparation plant

COAL IS SPLIT -NOT CRUSHED



Illustrations show American's exclusive manganese steel shredder ring and rotor assembly. Each shredder ring has 20 cutting edges. The high tonnage output of Americans at slow power-saving speeds is attained by the rapid reducing action of the multiple cutting edges of the rows of rings on the rotor as shown above.



The compactness of design and construction of American Type "S" Rolling Ring Crushers makes for a complete, high tonnage installation in minimum headroom requirements. No auxiliary crushing operations and equipment are necessary to the high performance of Americans—no extra picking and standby-cleanout labor is required.

An American Rolling Ring Crusher creates no refuse problem. Uniformly reduces ROM coal to stoker or pulverizer sizes—handling slate and pyrites and rejecting tramp iron—safeguarding against passing of large, non-crushable pieces.

There's an American to fit your operation. Capacities from 25 to 500 TPH.

The cross section at left shows American compactness of design and the exclusive shredder ring principle. Revolving on their individual shafts, the shredder rings deflect without damage from tramp iron. The crushing chamber is made up of sectional manganese steel liners. Housings are of heavy ribbed steel castings secured at dust-tight machined joints with coupling bolts. This makes for easy access to all crushing parts.

Send for bulletin: "Crushing Coal for Less Than 1c per Ton."

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

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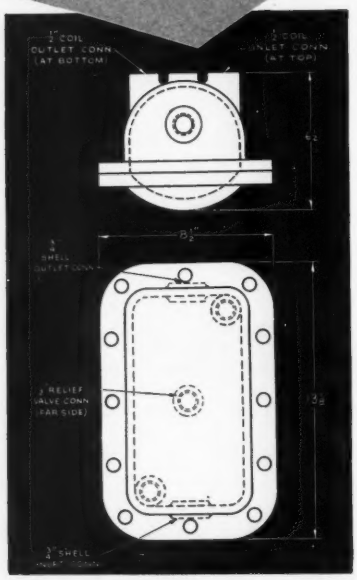
BOILER WATER SAMPLING MADE EASY



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BOILER WATER SAMPLING COOLER

saves many a headache when making boiler water analysis; samples to determine pH values and salt concentrations are now easily obtained. From the experience gained in hundreds of installations, Whitlock has developed a standard compact sampling cooler of optimum design with cast iron shell and stainless steel coil, adaptable for both low and high pressure requirements. Tubing is correctly sized to preclude air or oxygen occlusions in the sample which would affect conductivity cell readings. You will find this cooler a real help in maintaining high efficiency in your boiler room.

Write for further information.

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WHITLOCK HEAT TRANSFER EQUIPMENT

126 **Lubricants Service Handbook**—28 pages in this booklet on lubricants and their application. The development of the lubricant, its features and advantages and the manner in which it meets various operating conditions take up the fore part of the booklet. "Recommendations" section where the manufacturer tells just what grease or oil should be used according to speeds, temperatures, pressures and general service conditions is given. Fiske Brothers Refining Co.

127 **Oil Products for Industry**—Cutting oil, processing oils, general lubricants, refrigeration oils, Diesel oils, solvents, greases and waxes are among the petroleum products for industry which are described in this four-page folder. The various grades of each oil are analyzed and the reasons why they are fitted to each particular job are given. Sun Oil Co.

128 **Lubricania**—The hundreds of specialized lubricants in use today are identified by certain commonly used tests and terms which describe their physical characteristics. In this dictionary of terms, tests and values, the company has highlighted the most important of these. Tide Water Associated Oil Co.

POWER TRANSMISSION

129 **Speed Reduction, Increase Gear**—Bulletin S-130; description; gear cases; gear and pinion; bearings; lubrication; drawings and photos; 8 pages. The Troy Steam Turbine Co.

130 **V-Belt Drive Guide**—Bulletin B605-1F; guide to company's complete line of V-belt drives. Contents include types and sizes. V-belt prices, how to figure drives, belt selector charts and tables and similar engineering information. Well illustrated; 12 pages. Allis-Chalmers Mfg. Co.

131 **Chains and Sprockets**—Bulletin D-1; 2 color digest catalog, profusely illustrated, gives pertinent information on drive and conveying chains and sprockets, finished steel roller chains and sprockets, silent chains and sprockets, flexible couplings. Tables of numbers and pitches are given as are full page tables of list prices, dimensions and weights; 16 pages. Union Chain & Mfg. Co.

132 **Flexible Couplings**—Bulletin 57; 2 pages of drawings and tables of ratings for company's flexible couplings. Installations are shown and features of the various types are discussed; 20 pages. John Waldron Corp.

VALVES

133 **Regulating Valves**—Bulletin 1-A; valve data book, description, dimensions and lists of parts; typcial installations, rated capacities; prices; 52 pages. Atlas Valve Co.

134 **Pressure Regulator**—Bulletin 1-B; description, installation, operation; list prices; sectional and installation views; parts lists; 8 pages. Atlas Valve Co.

135 **Pressure Reducing Valves**—Bulletin 1-C; sectional drawings, list prices, dimensions and weights; operation and adjustment; capacities for steam and air; 12 pages. Atlas Valve Co.

136 **Corrosion Resistant Valves**—Two bulletins, both of them on corrosion resistant valves have just been issued. One of them, a techincal information bulletin covers the mechanical properties, analysis range, applications, advantages and sizes and specifications of the valves. The other is devoted to a photographic display of the installation of the valves. Alloy Steel Products Co.

137 **General Service Valves**—Bulletin E-150; valves for blow-off; fire pro-

IMO PUMPS

PERMIT DIRECT DRIVE AT ANY SPEED

The IMO pump can be connected directly to turbines, motors or other machinery without the use of reduction gears.

Operated at high speed, it is exceptionally small and compact in proportion to its capacity.

IMO pumps can be furnished for almost any capacity and pressure required for pumping oil, hydraulic control fluids and other liquids over a wide viscosity range.

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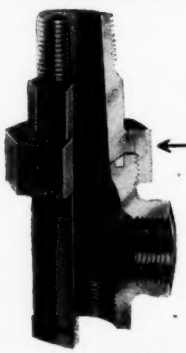

with the RECESSED BRASS SEAT

for Leakproof Piping

These Union Tees which have the union on the run will be found exceedingly useful where piping involves a union near a tee. They are rated "Tops" by engineers because they simplify installation, save pipe joints and assure permanent leakproofness. Made with pipe ends threaded either All-Female or Male and Female.

The Recessed Brass Joint in Jefferson Specialty Unions provides a brass to iron joint which avoids corrosion. It is forced into a machined recess and processed to insure a thorough, permanent tight contact between the ring and the spherical surface of the surrounding iron.

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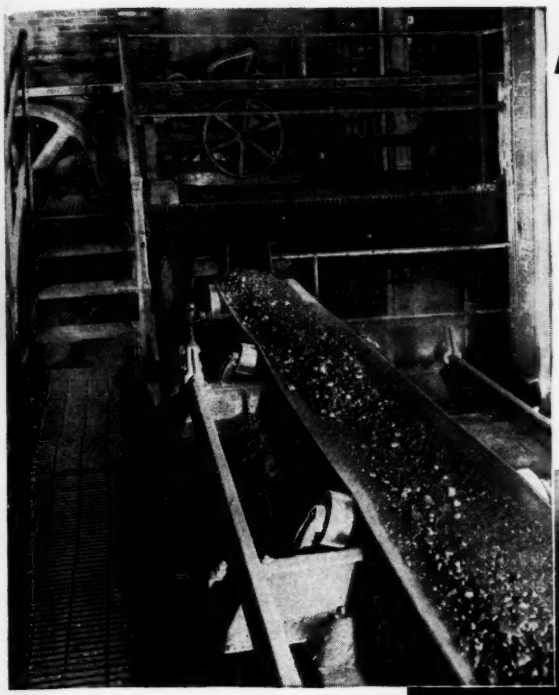
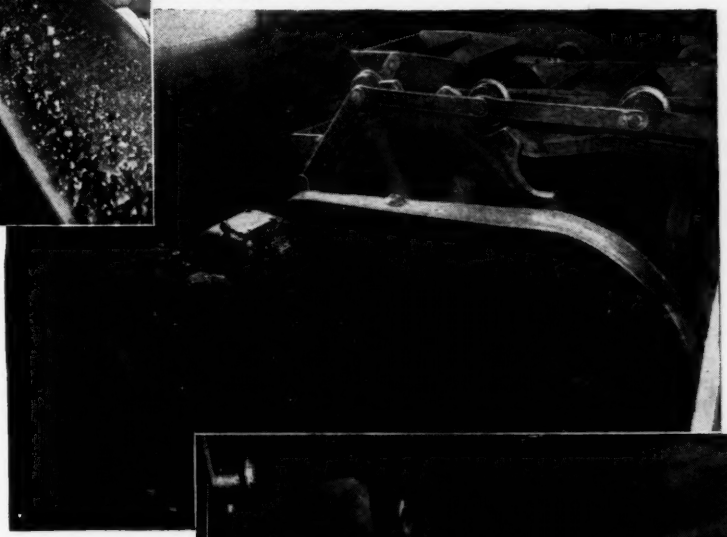
FLEXIBILITY and EFFICIENCY IN COAL HANDLING



← At top of boiler house, Peck Carrier discharges to L-B belt conveyor, which distributes coal in main bunker by means of self propelled tripper.

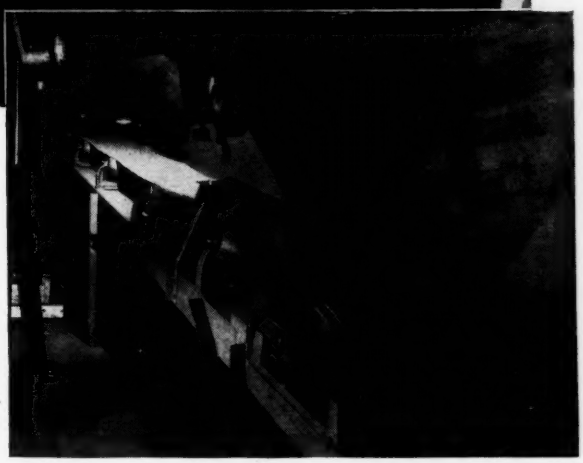


Good Planning with Good Equipment Pays Off at The Rath Packing Co.

• Fifty tons of coal per hour can be unloaded from railroad cars, crushed to size, then elevated and distributed throughout the length of the main bunker by the two Link-Belt belt conveyors and Peck Carrier shown in these views. Satisfactory performance of this equipment results not alone from its advanced design and quality construction but also from the experience and careful planning that determined its selection and layout.

Link-Belt Company can supply from its broad line, every type of conveyor, elevator, feeder and power transmission machinery, together with unbiased counsel based on the broadest experience with every type of industry.

↑ Drive of Peck Carrier includes L-B Herringbone gear speed reducer and L-B Silverstreak silent chain drive. This carrier receives coal as discharged from crusher in basement of plant and elevates it to top of boiler house. See upper left hand illustration.



↑ Below track hopper, reciprocating feeder and belt conveyor to carry coal to crusher.

•

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BOOST vacuum! SAVE coal . . .

Descale Condensers the Oakite way!

Here's how to bring up vacuum readings, reduce condensate temperature, cut coal costs: Descale waterside of condensers by circulating recommended solution of Oakite Compound No. 32, the inhibited, acidic-type descalant.

One Indiana public utility found they could descale condensers without taking them off the line, using the fast, penetrating action of the Oakite descalant to dissolve lime scale formations on tube surfaces. One day's saving in coal more than paid for the Oakite compound treatment.

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tection, soot blower lines, acids, process etc.; descriptions; exploded views; features; dimensions, weights and list price tables; parts and parts lists; 14 pages. Everlasting Valve Co.

138 **Valves**—Bulletin E-100; for boiler room service; photos, descriptions, parts; features; pressure rating indexes; size shipping weight and price tables; ordering information; 30 pages. Everlasting Valve Co.

139 **Multiport Relief Valve**—Bulletin 4150; complete description of valves and operating characteristics, photographs of typical installations. Engineering data includes sizing information tables, nomenclature, installation and operation, list prices of accessories, dimensioned drawings and tables of dimensions; 28 pages. Cochrane Corp.

140 **Steel Valves**—Bulletin 102; 4 page bulletin describing company's "Evrtyte" valves. Cross-sectional illustrations and tables of seat orifice sizes, prices and dimensions are given; listing of features, description of the operation of the unit and parts and prices for assemblies. Strong, Carlisle & Hammond Co.

141 **Tube Compensators Data Book**—Specifications and data for installation of flexible tubing compensators; typical installations are shown in columns of line drawings. Compensating data chart for calculating required tubing lengths; tables of thermal expansion of pipe, etc. Chicago Metal Hose Corp.

142 **Diaphragm Motor Valves** — 24 pages. Covers Why and How of unit's design. Materials specifications given as are two pages of engineering information and charts. Kieley & Mueller Co.

MAINTENANCE

143 **71 Maintenance Jobs**—This guide tells how better to perform commonly occurring power plant maintenance and cleaning operations. Illustrated manual gives specific material and method recommendations for handling cleaning, degreasing, descaling, derusting, paint stripping, etc. Booklet is completely indexed and reference is made by colored type strips on edge of the pages; 22 pages. Oakite Products, Inc.

144 **Protecting Metal**—High heat resistant coatings for protecting metal surfaces in power and processing equipment are covered in 4 page bulletin. Brief description of properties of coatings are given. The Dampney Co. of America.

145 **Condenser Tube Inserts**—Description of Flowrites; illustrated, accompanied by report of tests on Flowrites made by M.I.T. Tables and charts of test results are presented; description of how to install inserts given; 8 pages. Condenser Service & Engineering Co., Inc.

CONTROLS, METERS

146 **Damper Regulators**—Bulletin 4-A; for low pressure heating, medium pressure power and high pressure power boilers; what they do; how to specify; typical installations (drawings); adjustments; list prices; technical descriptions and parts lists; 20 pages. Atlas Valve Co.

147 **Thermostats and Relays**—Bulletin T, a 12-pg. catalog presents significant information on this company's mercurial thermostats and adjustable thermoregulators. Also included is complete data on relays, designed as companion instruments to the above mentioned. Complete descriptions of the instruments are included and the bulletin is well illustrated. Precision Thermometer & Instrument Co.

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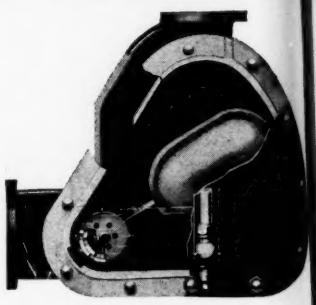

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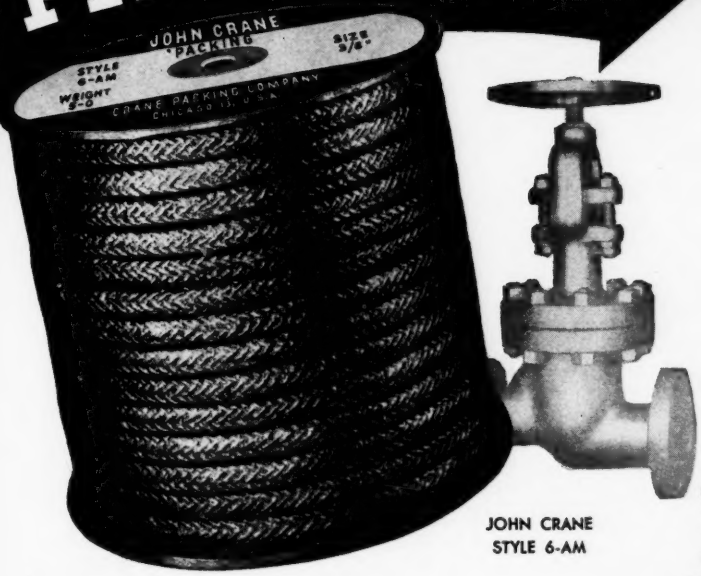

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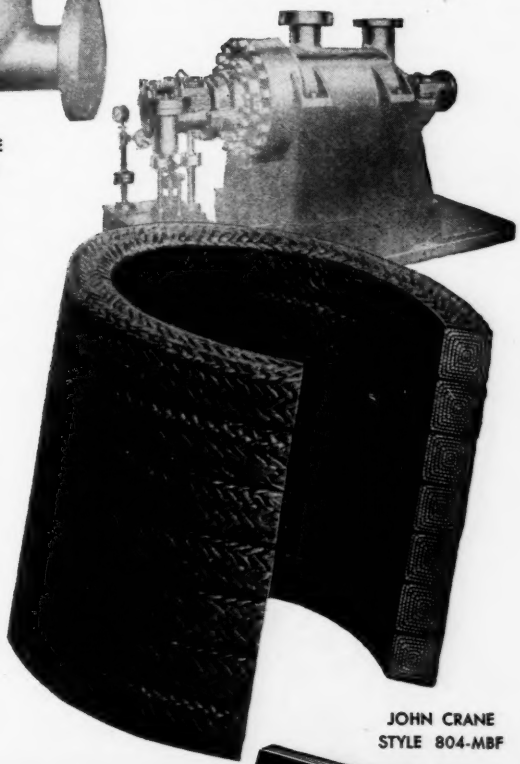

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148 **Recording Flow Meter**—Bulletin 349; what it does, features, chart of rated capacity; construction and operation; installation drawings, tables of capacity; photos; 8 pages. Builders-Providence, Inc.

149 **Propeller-Type Meter** — Bulletin 350A; for main-line metering; applications, description, installation, materials of construction; features; table of capacity, shipping weights; specifications, drawings; 4 pages. Builders-Providence, Inc.

150 **Water Works Controllers** — Three models of venturi filter effluent controllers for water works are described in Bulletins 321B and 325A. The former is an 8-page bulletin; the latter has 4 pages. Features of the controllers—such as precise control, low loss of head, compact and flexible design and others are described and illustrated. Builders-Providence, Inc.

151 **Centralized Combustion Control**—Bulletin 43-605; applications to various types fuels and burning equipment; controller, measuring elements, pilot device, power unit, etc.; 24 pages. The Hays Corp.

152 **Combustion Meters**—Bulletin 44-550; reasons why it is accurate dependable, simple, rugged, easy to install, easy to maintain, speedy, easy to understand; well illustrated by explanatory diagrams; 16 pages. The Hays Corp.

153 **Feedwater Textbook**—"Mechanical Feedwater Regulation for Boilers" by Prof. E. P. Culver; principles of feedwater regulation; mechanical equipment available; differential pressure control; feed pump control; illustrations, diagrams, charts; 36 pages. Northern Equipment Co.

154 **Engineering Monographs** — Series of eight on automatic combustion control; 1. How Close Can Steam Pressure Be Controlled? 2. Why Operate Automatic Combustion Control from Changes in Steam Pressure? 3. Adapting to the Characteristics of Underfed Stokers. 4. Adapting to Spreader Type Stokers. 5. Adapting to Chain or Traveling Grate Stokers. 6. Adapting to the Characteristics of Pulverizers. 7. Adapting to the Characteristics of Oil Burners. 8. Adapting to the Characteristics of Gas Burners; total 37 pages. The Hays Corp.

155 **Draft Gages**—Bulletin 46-667; gages for indicating, recording of drafts, pressures, differentials, temperatures; pressure-draft tables; descriptions of equipment; differential units, Bourdon tube units, pointer gages, etc; 20 pages. The Hays Corp.

156 **Draft**—Bulletin 46-472; what draft is; where it is found; how it is measured; what the draft gage tells, where to measure draft and pressure in steam plant; where to connect draft gages; how to install; drawings; 20 pages. The Hays Corp.

157 **Flue Gas Analyzer**—Bulletin 45-668; principle of operation; construction features; technique; models and prices; Burrettes—classifications and uses (table); what flue gas analysis tells us; 16 pages. The Hays Corp.

158 **Indicating, Control Systems**—What they are, what they can do; Bulletin 14B6641. Description of how transmitter, receiver and indicator of systems are constructed, how they work, their advantages and specifications. Illustrated with photographs, diagrams, charts; 12 pages. Allis-Chalmers Mfg. Co.

159 **Water Gages**—Condensed catalog, Bulletin E, of company's complete line of water gages. Each model illustrated and accompanying table gives

Silicone News

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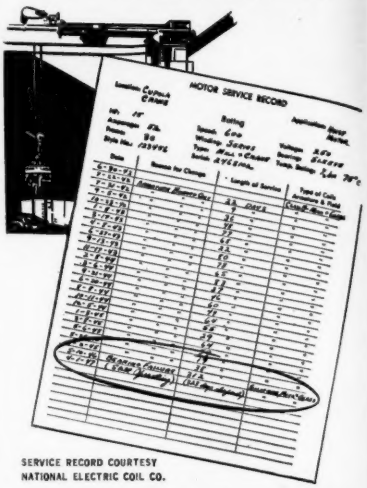

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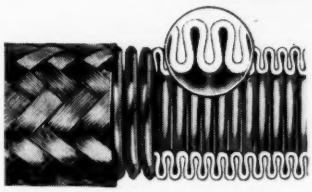

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1792

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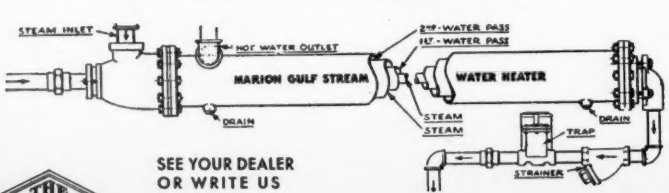

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sizing information; 8 pages. Ernst Water Column & Gage Co.

160 Stainless Steel Bellows—Bulletin SSB-46; contains diagrammatic cross-section views and up-to-date information concerning the use of these bellows as equalizers, compensators, expansion joints, flexible connectors for flow control, vapor and steam traps, thermostatic instruments, etc. Completely illustrated; 12 pages. Chicago Metal Hose Corp.

161 Pitot Equipment—Three section Bulletin 50; gives complete details of the use of Pitot tubes and rods, instructions in the use of the company's portable Pitot recorder, together with theory, formulae, notations and curves. Completely indexed; 20 pages. Simplex Valve & Meter Co.

162 Manometers — Bulletin 200; describes completely this line of fixed and portable manometers for use in water surveys and similar flow rate measurement, valuable engineering data also included. Illustrations include line drawings and photographs; 8 pages. Simplex Valve & Meter Co.

163 Instruments, Controls for Process—Bulletin 17; process controllers, control components, measuring components and instrument combinations briefly described and illustrated. Application data such as sizes, pressure standards and ranges are listed; 8 pages. Bailey Meter Co.

164 Temperature Regulators—Bulletin 7-A; six types; descriptions, list prices, tabular material, photos; list of parts; typical installation drawings; tables for finding sizes of control valves required to heat given quantity of water; 16 pages. Atlas Valve Co.

165 Draft, Excess Air and CO_2—Bulletin 39-341; discussion of the relation of these elements to the installation and servicing of bituminous and anthracite stokers by Arnold Soller; 12 pages. The Hays Corp.

166 Liquid Level Controllers—Bulletin A-100 is a four-page catalog describing this company's Types G and D liquid level regulators. Excellent cross-sectional views of the units are presented and their operational and constructional features are described. Dimensions, capacities and shipping weights are presented. Stets Company.

PACKING, GASKETS

167 Packing—Bulletin 237; photos and descriptions of use; installation drawings; standard size table; 4 pages. Warren Steam Pump Co., Inc.

FITTINGS

168 Standards for Flanged Fittings, Valves, Flanges—Pressure temperature ratings, tables and charts, rating procedure, flange materials, safety factors, loading, stress formulas; 20 pages. Tube Turns, Inc.

169 Welding Fittings—Allowable working pressures; power, oil, district heating, refrigeration, gas and air piping; 14 tables and directions for use; 18 pages. Tube Turns, Inc.

170 Welding Fittings—Volumetric capacities; 2 pages of formulas for computation of capacities; 6 pages of tables; 12 pages in book. Tube Turns, Inc.

171 Unions—Complete line of malleable iron unions and convenience unions; illustrations, descriptions, size and list prices; descriptions of materials and workmanship; 24 pages. Jefferson Union Co.

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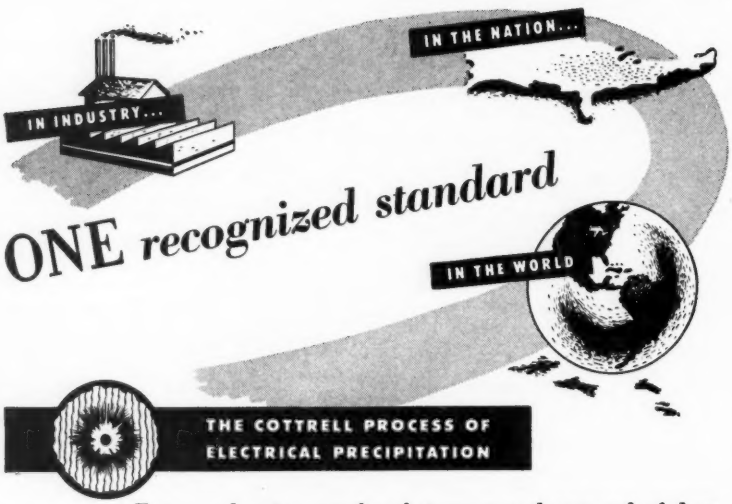

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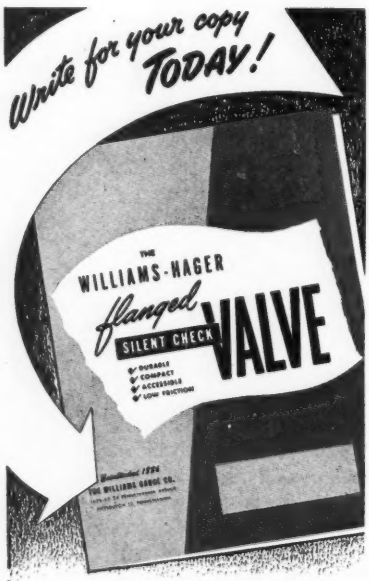

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PUMPS

172 **Horizontal Duplex Piston Pumps**—Bulletin 230-1; specifications, steam end, liquid end; capacity tables for pressure service, light pressure service; dimensions, drawing, tables; 4 pages. Warren Steam Pump Co., Inc.

173 **Steam Heat Vacuum Pumps**—Bulletin 226-1; specifications, drawings, general information, tables of sizes and capacities; 4 pages. Warren Steam Pump Co., Inc.

174 **Centrifugal Pumps**—Bulletin 302-30, Revised; instructions for installation and operation; drawings, tabular material; 12 pages. Warren Steam Pump Co., Inc.

175 **Hydraulic Pressure Pumps**—Bulletin 238; specifications, sectional photos, important features; full page table of capacity, sizes, pipe sizes, pressure; 4 pages. Warren Steam Pump Co., Inc.

176 **Screw Pumps**—Recommended uses; advantages; tables of capacities and sizes; charts of test results; dimensioned drawings; suctions and discharge, packing box sizes, shipping weights tables; specifications; installation and maintenance; theoretical horsepowers; viscosity classifications; 18 pages. Sier-Bath Gear & Pump Co., Inc.

177 **Centrifugal Pumps**—Booklet describes basic action of centrifugal pumps, tells of the science of centrifugal action and the physics of pumping. Performance curves are presented. Descriptions of the company's self-priming centrifugal pumps are given and how they operate is explained. Typical uses of the units are pointed out and installation and operation explained; 20 pages. Marlow Pumps.

178 **Centrifugal Pumps**—Bulletin 240, 6-page folder describing single stage, double suction, Type DBL centrifugal pump. Features of the pump resulting from its construction and engineering; a sectional view which is used to point out other advantages of the unit. Tables of metal specifications and capacity ratings in gallons are also given. Warren Steam Pump Co., Inc.

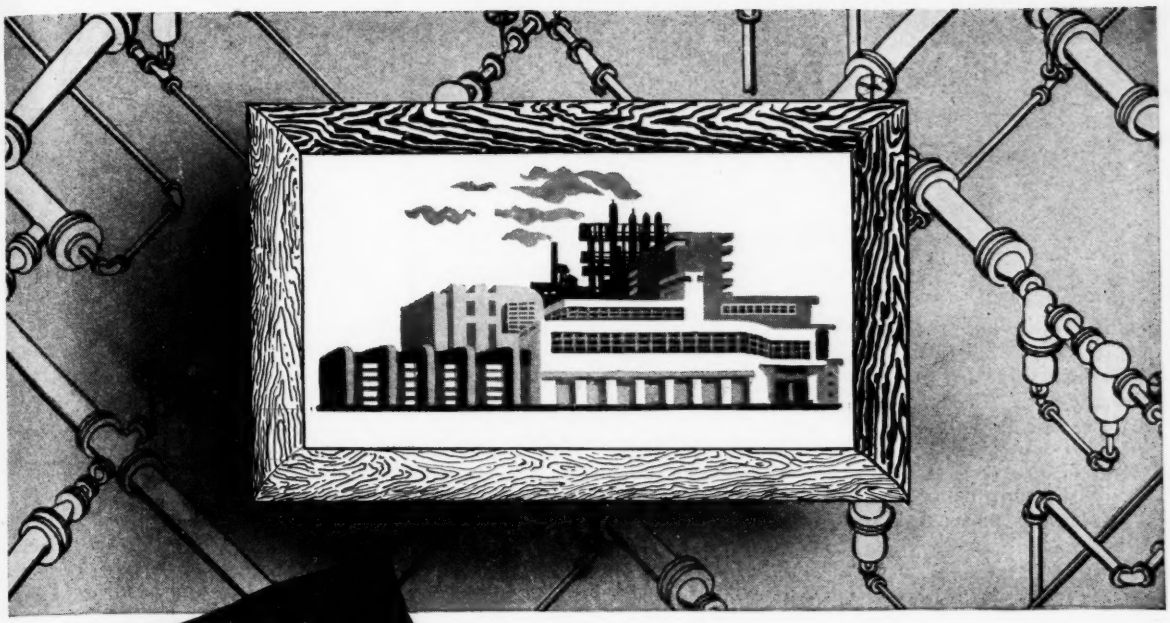
179 **Multi-Stage Pumps**—Bulletin 241 describes 4 and 6 stage Type TM pumps. Cross-sectional illustrations and tables of specifications are given. Dimensioned drawings and tables of dimensions accompany copy describing unit's construction and advantages. Warren Steam Pump Co., Inc.

180 **Close-Coupled Pumps** — Close-coupled pumps, called Compac-units, are described in Bulletin 242. This eight-page bulletin presents clear and understandable cross-sectional photos of the units and uses these to point out construction and operation features. A full-page "Composite Rating Table" presents rating information at various heads for 9 different models of pumps. Warren Steam Pump Co., Inc.

MISCELLANEOUS

181 **Floor Resurfacing**—This recently-published folder describes the methods of use of the company's heavy-duty resurfacer for use on floors, traffic aisles and loading platforms. It contains a concise, clear description of the properties, methods of application and advantages of the resurfacer and is of interest to everyone who has problems in the maintenance and repair of concrete floors. Stonhard Company.

182 **Electric Tools**—Bulletin 464; covers complete line of portable electric tools for construction and briefly describes such tools as electric hammers, drills, chisels, vibrating tools, accessories, screw drivers, etc. Prices are given. Syntron Co



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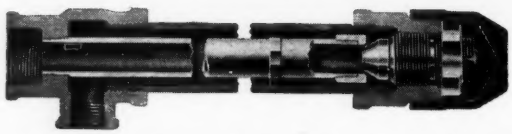
QUIET PLANT NOISE
with Nicholson Expansion Traps

Quiet operation is a feature of these "Continuous Discharge" Steam Traps



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183 Reractory Concrete—"Lumnite for Refractory Concrete"; basic information on materials and methods used in making refractory concrete. Illustrations show application of concrete in construction of furnaces, coke ovens, etc. Another section covers concrete use in foundations, floors and structures subject to high heat; 24 pages. Lumnite Division, Universal Atlas Cement Co.

184 Gas Purger for Refrigeration System—Bulletin 160; tells how to cut power costs and raise condenser capacity by proper purging of non-condensible gases. Tables of ammonia properties, advantages and complete illustrated material. Typical installations are pictured. Two pages with diagrams tell how purger operates; 8 pages. Armstrong Machine Works.

185 Grinding Wheels—Grinding wheels of various abrasives are illustrated and list prices presented; tables of sizes in inches are accompaniel by photographs and line drawings of these various wheels. Grinding wheel dressers with list prices are shown; 32 pages. Norton Co.

186 Weldments—Bulletin SP106, tells about the services of this company's weldry and the weldments turned out therein. The products of this weldry are shown and the text points out how flexible the method is by showing that it makes no difference if the finished product is constructed of light sheet or heavy metal . . . the resulting product can be made to exacting specifications. Graver Tank & Mfg. Co., Inc.

187 Drop Forged Flanges—Manufacturing processes; physical characteristics; full-page tables of illustrations, dimensions, weights and prices. Space provided for future insertions. Phoenix Mfg. Co.

New ENGINEERING BOOKS

Steam Power Plant Auxiliaries and Accessories by Terrell Croft; revised by D. J. Duffin, Second Edition, 1946; 583 pages; illustrated; 5½ by 8 inches; cloth binding; McGraw-Hill Book Company, 330 West 42nd Street, New York City; price $5.00.

For a long time there was a great need for the revised Second Edition of this book, which was originally included in the famous power plant series of Croft's. The other books in the series—on Steam Engines, Turbines, Boilers and Practical Heat—have been revised and are now fairly up to date. But for years the one on auxiliaries, one of the most important of the series, remained far behind the developments in equipment and methods that were taking place throughout the power engineering field. This situation has now been remedied in a very effective way by Mr. Duffin, formerly of Consolidated Edison Co. and National Research Council, who has brought the book up to date and completely revised it to conform with the recent changes.

About 250 pages of text and 300 illustrations are completely new. Revisions and additions, particularly noteworthy, are those dealing with pumping machinery, boiler feeding apparatus, economizers, feed-water heaters, steam traps and steam power plant piping, for in all these there has been much important development. An Appendix of tables and data has been added and material already covered in the revised editions of the other four books in the series is not duplicated in the present work.

For the first time, evaporators, deaerators, air preheaters, piping maintenance, certain types of pumps, motor applications, etc. have been treated in the present edition. It emphasizes the tendency toward higher pressures and temperatures and the effect of those on

plant design and operation. Recent recommendations of ASA and ASME in the various boiler and piping codes have been incorporated.

Of course, fundamental principles do not change and where those were included in the earlier book they remain here. Data on earlier types of equipment are also included, for these are still often found in operation.

The book is, in short, a very fine job and should be very useful to all power plant operators. It is the auxiliaries that they have most to do with in the way of selecting, specifying, operating and maintaining, for, once the major equipment is decided upon, its characteristics are pretty well fixed and cannot be changed much by the operator. The auxiliaries, however, he must understand thoroughly, for on these he can make many adjustments.

The book begins with a list of symbols and the discussion is covered under the following divisions: Pump Theory and Calculations; Reciprocating Pumps; Centrifugal and Other Impeller-Type Pumps; Injectors; Methods of Boiler Feeding; Feedwater Heaters, Deaerators, Evaporators; Economizers and Air Preheaters; Steam Condensers; Spray Ponds and Cooling Towers; Steam Piping of Power Plants; Steam Separators; Steam Traps.

The book is well indexed. It is highly recommended to all readers of POWER PLANT ENGINEERING as a most practical help in operation.

For This We Fought, by Stuart Chase; Number 6 in series When the War Ends, prepared for The Twentieth Century Fund; 124 pages; size 5½ by 7½ inches, cloth binding; published by The Twentieth Century Fund, 330 West 42nd Street, New York 18, N.Y., Price $1.00.

This book, published in the fall of 1946, is the sixth in a series devoted to the general subject of When the War Ends. The book was issued right at the time when our demobilization of the war effort had been under way for some time and therefore was written before the problems through which we have just passed had been seen in all their force. It was a good forecast of what we have been through during the past year or so.

Mr. Chase begins with an analysis of men in new suits—the veterans coming out of the armed services—reviews briefly what was being done to re-orient them into American life, and itemizes what the veterans want and what the people want. He correctly foresaw that public opinion would be changed by events, not by rhetoric.

He then reviews the five year miracle of our war effort, showing how in addition to the tremendous volume of war production, essential civilian needs were likewise taken care of by the use of all our available man power and woman power. One effect of this war experience, Chase maintains, is to destroy in one vast controlled experiment the notion that people who are not working are the kind of people who will not work. The bums and loafers of 1940 turned into the foxhole heroes, the flying fools, the dauntless naval crews of 1944.

Chase's conception is that this is not a record of economic ruin but of achievement and that the facts show that prosperity follows activity. He points out, moreover, that the accomplishments of the war period were made without going over to a socialist or collectivist state. He analyzes our ability to get what we want in the future in the way of jobs, production and security for our population and feels that historical forces are likely to select for us a mixed system, particularly one involving a factor of governmental planning responsible not for running the economy but for trying to keep it on a reasonably even keel. He feels definitely that a middle of the road program of this kind would not only be best for us but that it is definitely securable. He ends with a discussion of the implications of atomic energy on all our future plans.

The earlier books of this series, written from 1942 on, seem to us just as valuable today as when they were first published. The problems to which Mr. Chase set himself were then headline actualities and most of them are still with us. This series of short volumes

(*Continued on page 196*)

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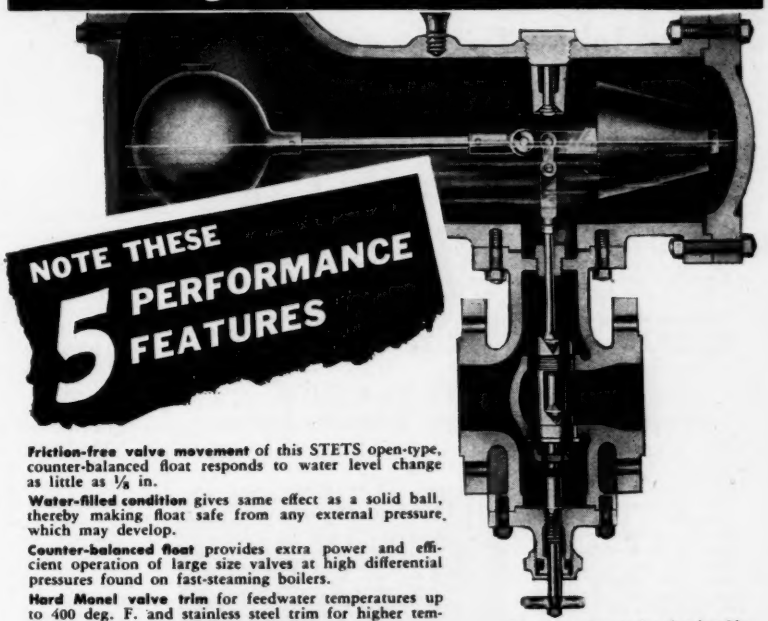

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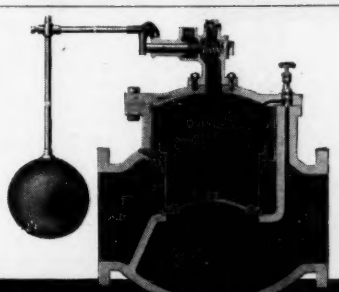

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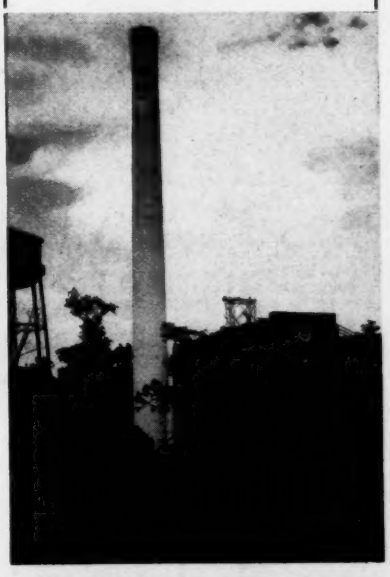

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POWER PLANT *Construction News*

Calif., Riverside—California Electric Power Co., Riverside, plans expansion and improvements in properties to cost about $4,000,000, including extensions in generating facilities, transmission lines, power substations and distribution system. Financing is being arranged and work will begin soon.

Conn., Bridgeport—United Illuminating Co., 1115 Board St., plans expansion and improvements in Steel Point steam-electric generating station, foot of East Main St., with installation of equipment. Cost estimated about $1,000,000. Work will proceed at early date.

Conn., Waterford—State Tuberculosis Commission, Capitol Bldg., Hartford, Conn., has preliminary plans under advisement for new boiler house at institution at Waterford, estimated to cost approximately $225,000, with boilers and auxiliary equipment.

Del., Dover—Richardson & Robbins Co., canned food products, has approved plans for new boiler house and water-treatment plant, with new one-story freezer building, estimated to cost about $80,000, with equipment. Erection will begin soon.

Ga., Lagrange—City Council has authorized plans for new municipal natural gas system, including control station, pressure pipe line for connection with supply source, distribution lines and other operating facilities. Cost reported close to $1,500,000. J. W. Goodwin Engineering Co., Martin Bldg., Birmingham, Ala., is consulting engineer.

Ga., Savannah—Savannah Electric & Power Co., 27 West Bay St., has authorized expansion in Riverside steam-electric generating station, with installation of new 20,000-kw turbine-generator and accessories, high-pressure boiler and auxiliary equipment, including switchyard addition and transmission line extensions. Entire project is reported to cost about $3,500,000.

Ill., Rockford—Central Illinois Electric & Gas Co., 301 North Main St., Rockford, has engaged Stone & Webster Engineering Corp., 49 Federal St., Boston, Mass., consulting engineer, to prepare plans for proposed new steam-electric generating plant on Rock River, recently referred to in these columns, reported to cost about $4,000,000, with turbine-generator, boilers and auxiliary equipment.

Ind., Jasper—Board of Public Works, Jasper, has plans maturing for extensions and improvements in municipal steam-electric generating station, with installation of equipment for increased capacity. Cost estimated about $120,000. CPA has approved project and work is scheduled to begin soon. Bevington, Taggart & Fowler, Pythian Bldg., Indianapolis, Ind., are consulting engineers.

Ind., Vincennes—W. P. Squibb Distilling Co., 312 Indianapolis, Ind., has plans for new boiler house, 48 x 54 ft at distillery, and will place work in progress in near future. Edward R. Gregg, Heyburn Bldg., Louisville, Ky., is architect.

Iowa, Independence—City Council is considering expansion and improvements in municipal power plant, with installation of new Diesel engine-generator unit and auxiliary equipment. Cost estimated approximately $200,000.

Mich., Detroit—Michigan Consolidated Gas Co., 415 Clifford St., has plans for new artificial gas-manufacturing plant, with boiler house, compressor station and other operating units, reported to cost close to $2,000,000, with equipment. Proposed to begin work at early date.

Minn., Maple Lake—Rural Cooperative Power Assn., Maple Lake, plans expansion and improvements in generating station, with installation of new 550-kw Diesel engine generator unit and auxiliary equipment. Fund of $1,890,000 has been arranged through Federal aid for this and extensions in transmission and distribution lines.

N. Y., Niagara Falls—Niagara Falls Power Co., has plans in progress for extensions in Schoellkopf hydroelectric generating station, with installation of hydraulic turbine and generator for increased capacity. Cost estimated close to $2,500,000. No time announced when work will begin.

N. Y., Richmond Hill—Consolidated Edison Co., 4 Irving Pl., New York, N. Y., has plans maturing for new power substation at Richmond Hill, estimated to cost approximately $500,000, with transformers, switchgear and other operating facilities.

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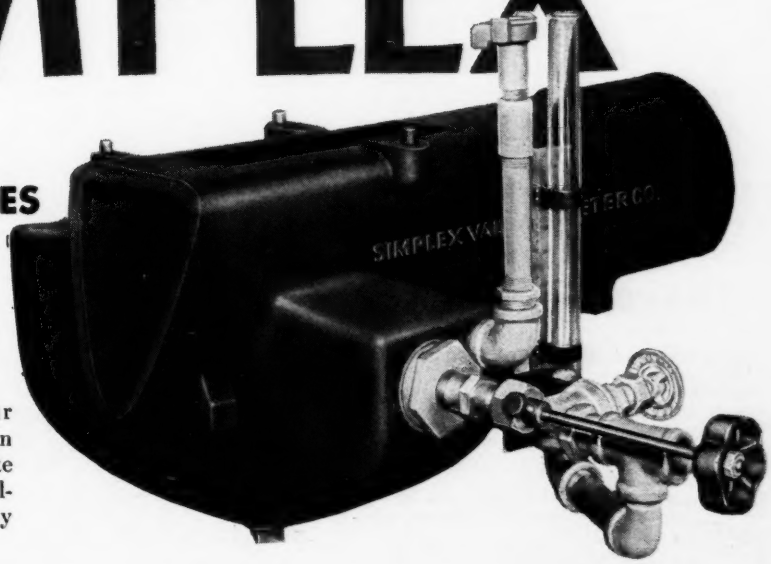

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N. Y., Willard—State Dept. of Mental Hygiene, State Office Bldg., Albany, N. Y., plans new power plant and incinerator works at Willard State Hospital, reported to cost close to $950,000. It is understood that project is scheduled to be carried out this year.

Okla., Oklahoma City—Oklahoma Gas & Electric Co., 321 North Harvey St., is reported planning new generating station on North Canadian River, site approximately 10 miles from Oklahoma City, to cost over $8,500,000, including transmission line extensions, switching station and other operating facilities.

Ore., Eugene—Eugene Water Board has authorized plans for new steam-electric generating station, to be used primarily for peak load and standby service. Installation will include a 25,000-kw turbine-generator unit and accessories, high-pressure boiler and auxiliary equipment. Cost reported close to $2,000,000. Plans also are under way for installation of new 7500-kw hydraulic turbine-electric generator unit at hydroelectric power plant at Leaburg, to cost about $400,000. Both projects are scheduled to be carried out this year.

Pa., Philadelphia—Philadelphia Electric Co., 1000 Chestnut St., has plans for new power substation at 19th. and Oxford Sts., estimated to cost over $100,000 with transformers, switchgear, etc. Work will begin soon.

Texas, Alibene—West Texas Utilities Co., Alibene, plans expansion and improvements in local steam-electric power plant, with installation of new turbine-generator unit, boiler and auxiliary equipment. Cost estimated about $1,100,000, with equipment.

Texas, Corsicana—Magnolia Pipeline Co., Magnolia Bldg., Dallas, Texas, affiliated with Magnolia Oil Co., same address, plans new electric-operated pumping station for crude oil service in vicinity of Corsicana, reported to cost over $400,000. Bids will be asked during summer.

Texas, San Benito—Central Power & Light Co., Corpus Christi, plans extensions and improvements in steam-electric generating plant at San Benito, with installation of equipment for increased capacity. Cost reported about $325,000.

Wash., Seattle—Dept. of Lighting, 1015 Third Ave., has preliminary plans under way for new automatic power substation in First Hills district, consisting of reinforced-concrete building, with transformers, swithgear and auxiliary equipment, reported to cost over $1,000,000. Project is scheduled to mature during summer.

Wash., Walla Walla—Pacific Power & Light Co., Portland, Ore,. plans expansion in properties in vicinity of Walla Walla, including power substations, transmission lines, distribution system extensions and other facilities. Cost estimated close to $575,000. Work will be carried out at early date.

Wash., Seattle—Puget Sound Power & Light Co., Stuart Bldg., has arranged an expansion and improvement program in plants and system during next 24 months for increased generating capacity, transmission and distribution, estimated to cost over $5,000,000. Work on different branches of project will be placed under way soon.

SEWAREN STATION STARTED

EXCAVATION has been started for the new Sewaren (N.J.) Electric Generating Station of Public Service Electric and Gas Co. Dredging and dock construction, the building of a bridge across Smith Creek and the construction of an access road have been completed. It is estimated the new station will cost $38,000,000.

Since last summer, 350,000 yards of fill have been removed from the Arthur Kill in the region of the new station's dock to provide a channel for coal barges and steamers. The fill was used to improve the property for the erection of the station.

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The plant will be located near the water, for receipt of water-borne fuel and for pumping cooling water from the Arthur Kill. Provision will be made to extend the plant by adding to the westerly end of the building. The present work will comprise a plant of 300,000-kilowatt capacity, with three turbine-generators and three steam boilers. Purchased in 1928, the entire property consists of 155 acres, of which 35 acres will be developed at this time.

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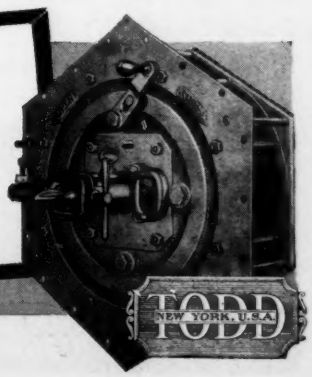

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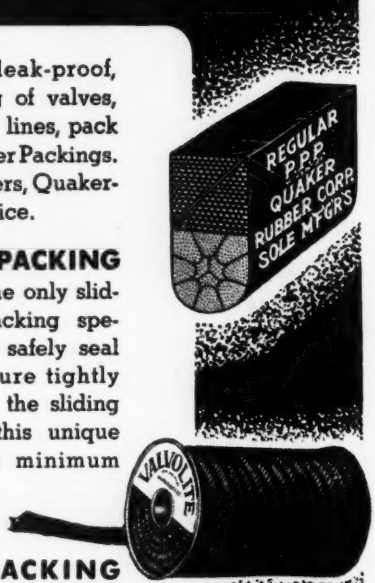

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NEW FRONTIERS for the young men of today offer far more possibilities for development than we have ever seen before. These frontiers will have to be conquered, however, by methods entirely different from those used in conquering the physical frontiers of the earth, for they are of a different type. For example, the ionosphere is one of them and although it is a physical entity in space, its conquest will involve not only the same quantities of physical bravery and stamina as in the past, but new characteristics of science, some of them as yet unborn or unknown. The ionosphere is only one of them. It is the section of upper space above the stratosphere beginning at approximately 45 miles above the earth's surface. The rocket tests at White Sands, New Mexico, are now providing science with new data about the upper atmosphere which may ultimately solve many of the present problems of meteorology and radio communications. Willy Ley, the rocket engineer, predicts that in future atmospheric sounding flights, tandem rockets may supplant the V-2 types now in use. These tandem rockets, which are still in the planning stage, will start from the ground, powered by a rocket or a jet-propelled booster which will lift them perhaps ten miles. Then this booster unit will be dropped and the main rocket motor will take over. Incidentally, in the present V-2 rockets being tested, the rocket structure and power unit weighs 6750 lb and at take-off carries almost 8 tons of fuel, which is alcohol and liquid oxygen. Initially it develops a thrust of 60,000 lb but at 30 miles altitude reduced atmospheric pressure increases the thrust to 69,000 lb. At top speed and acceleration a fantastic value of 600,000 hp is developed.

RECENT INFORMATION on methods of handling food, offered to restaurant operators through the new division of Food Research of the National Restaurant Association, should also be of interest to industrial engineers and managers for possible application in company lunch rooms and cafeterias. One trend is toward the semi-preparation of food to be used in the restaurant. Whole meals assembled and partly cooked, and ready to heat just before serving, have gained wide acceptance, especially by the airlines, as previously noted in these columns. Precooked foods containing protein, however, can be dangerous if improperly handled. A great deal of research work is being done by numerouse agencies to prevent trouble from spoilage of such precooked foods and it may be safely assumed that every precaution will be taken in this respect. Another idea useful for restaurants may be the use of dehydrated foods, which saved shipping space and weight during the war. In the restaurant they promise savings in kitchen labor. Research is being done on the aging of meat without mold or undue loss of moisture. A system of boning beef, developed at the Army Subsistence and Research Laboratory in Chicago during the war, saved much shipping weight and space. One of the most time-consuming kitchen jobs, peeling potatoes, has been reduced to a factory process.

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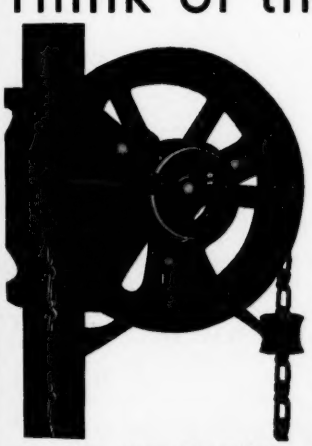

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NEW ENGINEERING BOOKS

(*Continued from page 189*)

gives the general public a moving and exciting panorama of the whole range of questions it must answer if it is to attain lasting prosperity and peace.

The first volume of the series, The Road We Are Traveling: 1914-1942, was published in April 1942. In it Mr. Chase gave his colorful interpretation of the sweeping changes in our social and economic life which took place between the two World Wars.

In the second book, Goals for America: A Budget of Our Needs and Resources, Mr. Chase put into words the needs of the American people that must be met to make a better world after the war. Using overall figures of the goods and services these needs demand, he argued that we have ample manpower and resources to produce them.

In a third volume, published in 1943, entitled Where's The Money Coming From?: Problems of Postwar Finance, he carried the discussion one step further. He maintained not only that we shall have the manpower and plant to produce these postwar demands, but that we shall be able to finance the full employment of our human and material resources.

In the fourth book of the series, published in January 1945, Democracy Under Pressure, Mr. Chase pointed out that the United States must be united in fact as well as in name if its high destiny is to be fulfilled. He portrayed the drift toward monopoly in business, agriculture and labor that is preventing us from achieving the maximum volume of employment and production; and he indicted the great pressure groups for threatening to divide the nation by placing their own selfish economic interests above those of the public.

In Tomorrow's Trade, Mr. Chase analyzed the bewildering complexities of international trade, foreign exchange, overseas loans and investments, to reveal the basic essentials of sound economic policy. These are to accept a large volume of imports, to help break down barriers to the free exchange of goods and services throughout the world, and to finance recovery abroad.

Mr. Chase is one of our leading expositors of technical and business facts in language that non-technical readers can understand. He has been doing this for years, beginning with his famous volumes on Men and Machines, and the Tragedy of Waste. One thing that impresses many engineers about his writings is his use of data with which they are already familiar in their own work and which they know cannot be controverted. That makes it relatively easy to evaluate the conclusions Mr. Chase draws from facts they are willing to accept. But his writing is always vigorous, alive and persuasive, he speaks straight out from the shoulder, frequently stepping on sacred toes and twisting the tails of sacred cows—and that is an attitude many engineers can appreciate. They ought to read his books, we feel, particularly this series for The Twentieth Century Fund, to see if they agree with his ideas, for they are the men whose work is largely responsible for them.

The Art of Plain Talk. by Rudolf Flesch; 210 pages, 5 by 8 inches, cloth binding; published by Harper & Brothers, 49 E. 33rd Street, New York, N.Y.; price $2.50.

Plain talk is one of the hardest things in the world, not one of the easiest, as many people think. We live in a world where a great deal of public and private business has to be done in print or typewriting; nearly everybody must write. In this book, Dr. Flesch offers sound, practical rules for producing readable writing in which we make things as clear as we can. He is not trying to talk about the production of "literature."

He begins by pointing out that plain talk is an art and that mere knowledge of the rule is not always enough. *How* do you make sentences short, compact? *How* do you use simple words and still say what you want to say so that the reader or hearer cannot misunderstand you?

Let's start with the Chinese, he says. He analyzes how the Chinese connect ideas in a very simple manner; first, by getting rid of empty words and syllables and second, by sticking to the subject—predicate—object order in their language.

Next, says Dr. Flesch, listen to plain talk as it is talked by ordinary people or even by not-ordinary people. Plain conversational talk is not difficult ideas expressed in easy language; it is rather abstractions embedded in small talk. It is heavy stuff packed with excelsior. He goes on to explain the difference between something that is a sentence and something that is not. Then he talks about gadgets of language. These are words that cannot by themselves express a complete idea but refer to something outside language, also parts of words, called affixes, like *dis*—and he gives you some help on cutting down on these.

He gives a yardstick (based on length of sentences, reduction of affixes and increasing the number of references to people) for testing your own plain talk. He shows the difference between live words and dead words, crowded words and empty words. He discusses punctuation and some of the tricks of rhetoric. His chapter on short-cuts is especially good, for it analyzes things like newspaper headlines and the "Gobbledygook" of the politicians.

After a discussion of textbooks and technical writing, he gives some good examples of how technical matters can be explained simply—and of how some cannot. He concludes with examples from the Federal Register to show how the complicated legal stuff of many of our laws could be simplified so that people can understand them.

We heartily recommend this book to all engineers, for it will help them tremendously in all the writing and speaking they have to do. Many of them, we note with some pride, already know how to do many of the things Dr. Flesch advocates, even though they may not know all the reasons for them. Technical writing and speaking involve ideas not always easy to grasp. But, as many technical writers have shown, even technical subjects can be made more understandable and readable.

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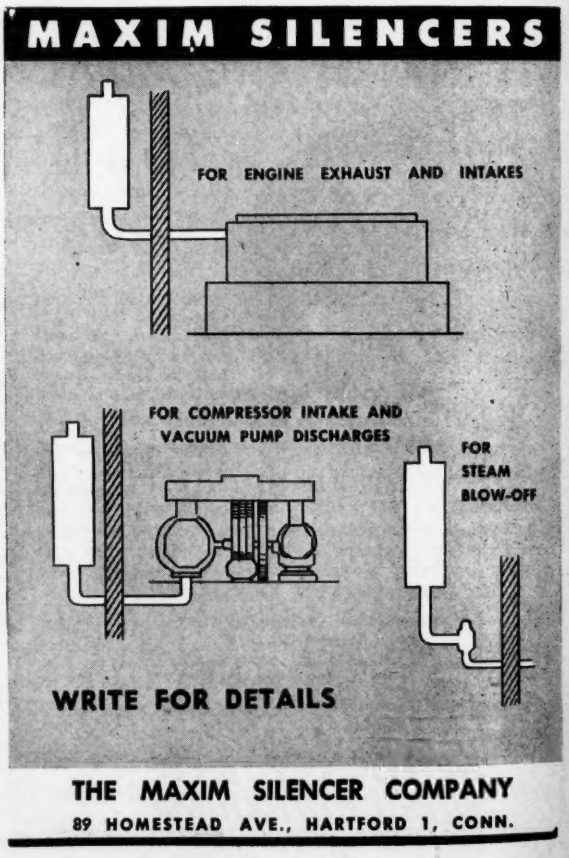
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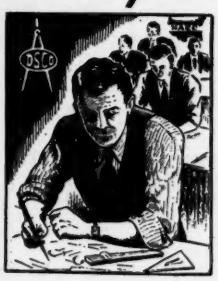

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Endless Horizons, by Vannevar Bush; 182 pages, size 6 by 9 inches, cloth binding; published by American Council on Public Affairs, 2153 Florida Aevnue, Washington 8j, D.C.; price $2.50.

The material in this book is based on a number of speeches, reports and recent writings of the famous Dr. Vannevar Bush, in some cases revised and brought up to date as necessitated by current developments. The title of the book is appropriate, for a thorough consideration of Dr. Bush's ideas leads one to the conclusion that there are literally endless horizons for the human mind as the boundaries of human knowledge are pushed farther and farther outward.

The possibilities of the immediate future, inherent in present developments, are most apparent to those who have the most intimate inside knowledge of what is going on and this is true of Dr. Bush. For example, at one point he calls attention to the need for new developments in photography that may enable us to develop a picture within a relatively few seconds or minutes after exposing it, thus enabling us to look at it and, if it is not satisfactory, take another one immediately. The article in which he mentions this was published in the middle of 1945 and we have recently seen the announcement of a new type of camera that makes exactly this operation possible.

For engineers, the book would be noteworthy for two features. These two are the inclusion of the famous Atlantic Monthly article "As We May Think," and the famous address by Dr. Bush before the AEC in 1939 on "The Qualities of a Profession."

In the first of these, published as Chapter 2 in the book, Dr. Bush calls attention to the serious problem of how we can make our tremendous technical knowledge available, so that it can be used conveniently and effectively. One method of doing this is to combine our methods of transmitting and reviewing the results of research by the new techniques of photography, recording devices, and processes, automatic speech typing machines, special tabulating and counting machines for mathematical operations, techniques of selection by use of the principles employed in punch-card machines, and finally the development of a device called the Memex to which we have made frequent reference in POWER PLANT ENGINEERING.

The Memex would consist of a filing system in which a great amount of material on various subjects would be stored in the form of microfilm with devices for reading it on various types of screens. Most important of all, proper indexing methods would permit information to be found, collected and utilized by association of ideas, which is the way we do it anyway, rather than by subject indexes.

The other important paper for engineers, "The Qualities of a Profession," should be read with great care because it emphasizes the common attribute of all professions," simple ministration to the people" and shows how, unless engineers can accept that as a central theme, they will have no truly professional spirit to build upon. Dr. Bush is optimistic that there are enough engineers who not only have, but practice, this attitude in their daily work, so that the ranks of engineers can attain the heights of true professional status.

In discussing the public welfare, Dr. Bush emphasizes the importance of basic research, the various methods by which governmental, industrial and other research can be made most effective, the need for international exchange of information and the special need for federal support.

In a chapter on the renewal of scientific talent, he analyzes the wartime deficits of scientific and research workers, points out the need for a program for making up this deficit and gives some suggestions for such a program. The book represents the mature thinking of a man who has attained the highest authority as a mathematician, an electrical engineer, a teacher and a scientific administrator. It presents a combination of unusually wide knowledge of scientific and technical matters, combined with a knowledge of practical industrial and political affairs. But most important of all, this knowledge is illuminated by an intense humanism and an understanding of human characteristics, together with a philosophical turn of mind and a skill in the expression of ideas, that are unusual. It is no wonder that this combination of characteristics has brought him to a position of esteem that few men of science have ever attained in any age.

A general idea of the contents of his book is given by the following tabulation of chapter headings: The Inscrutable Past: As We May Think; A Program for Tomorrow; The War Against Disease; The Public Welfare; Renewal of Scientific Talent; Reconversion Opportunities; The Means to the End; Research on Military Problems; The Control of Atomic Energy; Research and the War Effort; The Teamwork of Technicians; The Qualities of a Profession; Our Tradition of Opportunity; The Need for Patent Reforms; Science for World Service; The Builders.

The book should be required reading for all students in engineering colleges and for all engineers who are candidates for registration as professional engineers. In our opinion, if they are to be called professional engineers, they must learn to do more of the type of thinking typified by this book.

Standard Practices for Low and Medium Speed Stationary Diesel Engines, Third Edition, 1946; 157 pages, illustrated; size 6½ by 8½ inches, cloth binding; published by Diesel Engine Manufacturers Association, 1 North LaSalle St., Chicago 2, Ill.; price $2.50.

Numerous changes in Diesel engine equipment and practices have occurred since the first two editions of this book were published and the present volume has been revised to take those changes into account. It is intended to bring up to date the industry's standard practice with respect to the types of engines commonly used in stationary power plants. The book aims to be of service to Diesel engine users, prospective buyers and consulting engineers. It covers stationary Diesel engines at speeds up to and including 750 rpm

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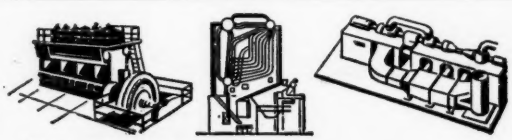

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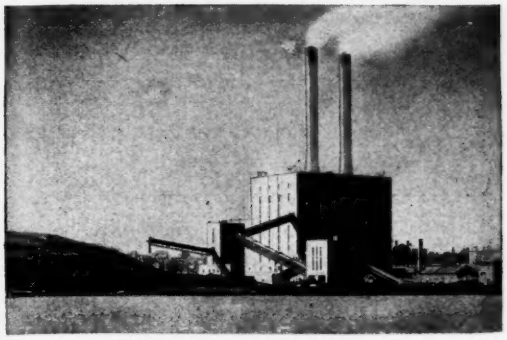

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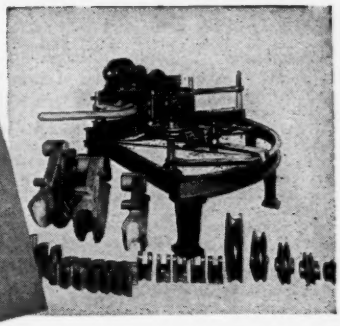

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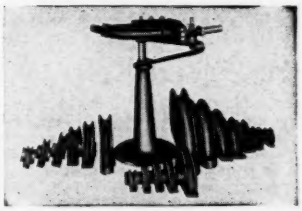

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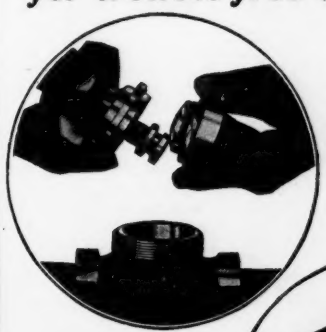

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and supersedes all previous editions of the DEMA standards. It is based on data agreed upon by a large number of Diesel engine manufacturers who are members of DEMA.

The book begins with an index of diagrams and charts. Then follows a chapter on definitions of terms used in Diesel engine practice. Subsequent chapters discuss Standard Performance and Equipment; Diesel Engine Construction; Governors and Speed Regulation; Torsional Vibrations and Critical Speeds; Intake and Exhaust Systems; Heat Recovery Apparatus and Air Starting Equipment; Cooling Water systems; Lubricating Oil Systems; Fuel Oil Storage and Handling Systems; Generators and Electrical Equipment; Selection of Engine Sizes; Diesel Power Plant Buildings; Erection of Diesel Engines; Lubricating Oil Characteristics and General Specifications; Fuel Oil Characteristics and General Specifications; Field Test Code; and Suggestions Covering the Preparation of Invitations for Bids and Detailed Specifications.

The last chapter on bids and specifications gives in complete detail a suggested form of invitation to bidders, a suggested proposal form and forms for tabulating all details of equipment and construction involved in the erection of a Diesel engine plant. The book is well indexed and well illustrated and is heartily recommended to anyone concerned with the Diesel engine.

Panel Heating and Cooling Analysis, by B. F. Raber and F. W. Hutchinson; 208 pages, illustrated; size 6 by 8½ inches, cloth binding; John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16; price $3.50.

The intense interest in radiant heating and cooling now being exhibited in both the domestic and industrial fields is reflected in the present book, which meets the needs for collections of fundamental information on these subjects.

It follows closely on the heels of the recent book Radiant Heating by Adlam, but differs from it principally in including much more theoretical discussion of principles with mathematical demonstrations of them. The student or practicing engineer using this book will need to know considerable higher mathematics to read it. It should be extremely useful to designers of radiant heating and cooling equipment and installations. However, the first section, Chapters 1 through 4, is composed of non-technical descriptive material on the background, development, advantages, disadvantages and types of installations of panel heating and cooling systems. An engineering education is not a pre-requisite to an understanding of these chapters.

The second section, however, making up the greater part of the book, is intended for design engineers and research workers and as a textbook for senior and graduate engineering students. It presents a detailed and rigorous treatment of the theory of radiant exchange and mathematical analysis of radiant panel heating and cooling systems. Its object is to provide the engineer with sufficient detailed understanding of design procedures to carry out a complete rational design or to evaluate some of the practical methods that are in use.

The third section presents simplification of the rational design procedure and discusses their degree of approximation.

The design procedure as developed is applicable to all types of panel heating and cooling systems whether energized by hot water, steam, warm air or electricity. The method of bringing heat to the panel surface is not discussed since this is essentially a commercial problem. Mathematical elegance has been sacrificed in the numerical examples in favor of less direct but more obvious and equally exact procedures.

The subject is covered under the following chapter headings: Introduction; Types of Heating Panels; Advantages of Panel Heating and Cooling; Disadvantages of Panel Heating and Cooling; Radiation Equations; The Comfort Relationship; The Mean Radiant Temperature; Evaluation of Shape Factors—Planar Surfaces; Evaluation of Shape Factors—The Human Body; Evaluation of Shape Factors — Approximates and Examples; Heat-Balance Equations; Simplified Heat-Balance Equations; The Equivalent Conductance Design Procedure. This book is indexed.

Rarer Metals, by Jack DeMent and H. C. Dake; First Edition, 432 pages; size 6 by 8¾ inches; illustrated; cloth; published by Chemical Publishing Co., Inc., 26 Court Street, Brooklyn, N. Y.; 1946; price $7.50.

The outstanding characteristic of the metallurgy of the 20th Century is the commercialization of a large number of rarer metals.

This volume by Jack DeMent and H. C. Dake correlates basic data on rarer metals for the busy professional man and student. It is suitable as a reference text or for supplementary reading in science and engineering courses.

Some 20 elements, excluding the metals of the rare earths on which there is extensive literature, are discussed briefly, including some of the interesting and important practical aplication of these elements. For example, rhodium makes the best mirrors, columbium corrects intergranular corrosion of stainless steel, tellurium improves the quality of lead and of rubber, tungsten makes our toughest steels, beryllium renders copper hard and fatigue-resistant, barium is our best electron emitter, uranium the most fascinating of all rare metals.

The book does not give a survey of analytical methods which may be found in any standard reference work on analytical chemistry, but newer tests such as those of microchemistry and flurochemistry have been discussed. The stress has been laid upon specific tests which can be performed rapidly with simple equipment and with satisfactory results.

Good illustrations, and up-to-date bibliography and a detailed index add greatly to the value of this text on the less familiar elements. Jack DeMent is co-author with Mr. Dake of Uranium and Atomic Power, Fluorescent Chemicals and Their Application, Ultraviolet Light and its Applications, and is at present Research Chemist at the Fluorescent Laboratory. Mr. Dake is the Editor of The Mineralogist.

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